SELECTED

ESOURCESABSTRACTS



VOLUME 2, NUMBER 20 OCTOBER 15, 1969 Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



SELECTED WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior



VOLUME 2, NUMBER 20 OCTOBER 15, 1969

W69-08127 -- W69-08628

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

	•••
FOREWORD	

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

- 01 NATURE OF WATER
 Includes the following Groups: Properties; Aqueous Solutions and
 Suspensions
- WATER CYCLE
 Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.
- 03 WATER SUPPLY AUGMENTATION AND CONSERVATION
 Includes the following Groups: Saline Water Conversion; Water
 Yield Improvement; Use of Water of Impaired Quality; Conservation
 in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.
- 04 WATER QUANTITY MANAGEMENT AND CONTROL Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.
- O5 WATER QUALITY MANAGEMENT AND PROTECTION
 Includes the following Groups: Identification of Pollutants; Sources
 of Pollution; Effects of Pollution; Waste Treatment Processes;
 Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,

TO METEOROLOGICAL CONDITIONS, Vanderbilt Univ., Nashville, Tenn.; Office of the Surgeon General (Army) (South Vietnam); and Johns Hopkins Univ., Baltimore, Md. J. E. Edinger, D. W. Duttweiler, and J. C. Geyer. Water Resources Research, Vol 4, No 5, Oct, 1968. 7 p, 1 tab, 10 ref. p 1137-1143.

Descriptors: *Heat transfer, *Mathematical model, *Heat, Thermodynamic behavior, Specific heat, Latent heat, Solar radiation, Conduction, Evaporation, Vapor pressure, Wind velocity, Air temperature, Atmospheric pressure, Water temperature, Dew point, Time lag, Heat budget, Meteorology, Meteorological data.

*Thermal exchange coefficient, Identifiers: *Equilibrium temperature, Back radiation, Convection, Stefan-Boltzmann law, Atmospheric radia-

tion, Reflected radiation.

The exchange of heat across the air-water interface is one of the more important factors that govern the temperature of a water body. The net rate of heat exchange at the water surface is the sum of the rates at which heat is transferred by radiative processes, by evaporation, and by conduction between water and overlying air. The net rate can be evaluated in terms of a thermal exchange coefficient and an equilibrium temperature, both of which depend on observable meteorological variables. Any one of the many evaporation formulas and mathematical descriptions of the other heat exchange processes may be used to develop equations involving the thermal exchange coefficient and equilibrium temperature. Such equations are and equilibrium temperature. Such equations are useful in developing relations that describe the temporal and spatial temperature distributions within a water body. They provide additional insight into the effects of meteorological conditions. on water temperatures, and they facilitate esti-mates of various terms of the heat budget. (Motzanderbilt) W69-08417

OBSERVED DIFFRACTION PATTERN AND PROPOSED MODELS OF LIQUID WATER, Oak Ridge National Lab., Tenn. Chemistry Div. A. H. Narten, and H. A. Levy. Science, Vol 165, No 3892, pp 447-454, Aug 1969.

Descriptors: *Water structure, *Hydrogen bonding, *X-ray diffraction, Molecular structure, Water properties, Crystallography, Model studies. Identifiers: Water (Liquid structure).

Various structural models proposed to explain the observed X-ray scattering by water are examined. Most of the models are incompatible with observed scattering or are insufficiently defined at the molecular level for adequate testing. Distorted bond models, gas hydrate models, and ice-structural models are considered. Only an ice-I model agrees with calculations of both small and large angle X-ray scattering. Conditions which must be met by reasonable water-structure models are given. (Knapp-USGS)

02. WATER CYCLE

2A. General

8 p, 3 fig, 38 ref.

GEOMORPHOLOGY, Heidelberg Univ. (West Germany); and Univer-sitaet des Saarlandes, Saarbruecken (West Ger-

For primary bibliographic entry see Field 02B. W69-08226

ON A METHOD OF FLOOD FORECASTING USING A DIGITAL COMPUTER CONNECTED WITH A WEATHER RADAR, National Research Center for Disaster Prevention,

Tokyo (Japan).

Masami Sugawara.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 161-169, 1968. 9 p, 8

Descriptors: *Weather data, *Analog computers, *Digital computers, *Flood forecasting, Rainfallrunoff relationships, Radar, Remote sensing, Telemetry. Identifiers: *Japan, *Hybrid computers.

Experiments were carried out in Japan using weather radar information, converted from analog to digital form, in a digital computer to forecast floods. The rainfall data were calibrated by comparison with rain gage data. Data were recorded on video tape for transportation from the radar instalvideo tape for transportation from the radar instal-lation to the computer. Because radar echoes are very high-frequency phenomena and floods are very low-frequency phenomena, information densi-ty at the radar site is reduced using the simplest analog method possible, and the resulting low-frequency data are presented on a polar coordinate mesh. (Knapp-USGS)
W69-08229

A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EFFECTIVENESS IN SOLVING RUNOFF ANALY-

National Research Center for Disaster Prevention,

Tokyo (Japan).

M. Sugawara. Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 170-174, 1968. 5 p. 4

Descriptors: *Rainfall-runoff relationships, *Computer models, *Analog computers, *Digital computers, Telemetry, Radar, Snowmelt, Runoff forecasting, Streamflow forecasting, Computers, Rainfall,

Runoff, Forecasting. Identifiers: *Japan, *Hybrid computers.

In Japan, digital rather than analog computers are used to analyze rainfall-runoff relationships. used to analyze rainfall-runoff relationships.
Analog computers are less flexible for many purposes than digital computers. For example, in calculating the effect of snow deposit and snow melt, or the effect of irrigation to paddy fields, analog computers are not effective. As hydrological data are mainly given in digital form, because of their low frequency, digital computers are convenient because of their digital input and output. To use analog computers with digital imput, systems which somewhat resemble hybrid computers may be con-structed. Analog computers are effective for their proper purposes, so combining them with digital computers can result in powerful systems. An example is the connection of a digital computer with a weather radar. In this case, the analog system is set at the radar site as the preparatory system for a digital computer. (Knapp-USGS)

SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS,

Institute of Hydrotechnical Research, Bucharest

For primary bibliographic entry see Field 02E. W69-08232

PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION PROGRAM.

General Electric Co., Santa Barbara, Calif. TEM-

For primary bibliographic entry see Field 07C. W69-08236

APPLICATIONS OF COMPUTER TECHNOLO-GY TO HYDROLOGIC MODEL BUILDING, Agricultural Research Service, Chickasha, Okla. Southern Plains Branch. For primary bibliographic entry see Field 07C. W69-08237

HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM,

Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center. For primary bibliographic entry see Field 07C. W69-08239

AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM RIVER FORECASTS ON THE NORTH COAST OF CALIFORNIA,

Weather Bureau, Sacramento, Calif. River

Forecast Center.

R. J. C. Burnash, and R. L. Ferral.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 300-306, 1968. 7 p, 3 fig. 3 ref.

Descriptors: *River forecasting, *Digital computers, *Data processing, *California, Rainfall-runoff relationships, Antecedent precipitation, Snow-packs, Snowmelt, Rainfalls, Winds, Temperature, Runoff, Hydrographs, Synthetic hydrology, Runoff forecasting.
Identifiers: Northern California rivers.

The north coast of California is generally composed of mountainous basins ranging in altitude from sea level to elevations in excess of 6000 feet. Stream data sampling is concentrated in the lower elevations. Historical storms have produced runoff volumes in excess of 30 inches. Precipitation occurs primarily in the winter months, generally as snow in the upper elevations. A computerized technique is described which provides a timely discharge forecast. Precipitation includes an approximation of wind influences during the storm period and is determined for all basins from limited wind, temperature and precipitation data. Surface runoff is computed from antecedent rainfall, a seasonal parameter and effective basin rainfall. The outflow hydrographs for 15 basins are synthesized from surface and subsurface flow computations. (Knapp-USGS) W69-08243

COMPUTATIONAL ANALYSES OF MOISTURE FLUX OVER NORTH AMERICA,

Travelers Research Center, Inc., Hartford, Conn. For primary bibliographic entry see Field 02B. W69-08244

OPERATIONAL STREAMFLOW FORECAST-ING WITH THE SSARR MODEL,

Weather Bureau, Portland, Oreg. River Forecast

For primary bibliographic entry see Field 02E. W69-08245

LAG TIME OF NATURAL CATCHMENTS, New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 02E. W69-08250

A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING WATER RESOURCES ENGINEERING, Technion - Israel Inst. of Tech., Haifa. Lowdermilk Faculty of Agricultural Engineering.
For primary bibliographic entry see Field 06A.

W69-08251

Group 2A—General

AN OUTLINE OF POLAND'S HYDROGRAPHY (POLISH).

Warsaw Univ. (Poland). Faculty of Biology; Warsaw Univ. (Poland). Faculty of Geography; and Warsaw Univ. (Poland). Faculty of Geophysics.

Zdishaw Mikulski.

Available from Clearinghouse as TT65-50375 at \$3.00 in paper copy. Warsaw, Poland, Sci Publications Foreign Coop Center of Cent Inst for Sci, Tech and Econ Inform. 1968. 337 p, 47 fig, 1 map, 28 tab, 331 ref.

Descriptors: Hydrography, *Surface waters, *Groundwater, Synoptic analysis, Climatology, Meteorlogy, Rainfall-runoff relationships, Surfacegroundwater relationships, Streamflow, Rainfall, Runoff, Infiltration, Hydrologic budget, Evapotranspiration. Identifiers: *Poland.

The groundwater and surface water hydrography of Poland are discussed in a textbook intended for professional hydrologists and water managers. Studies in synoptic hydrology, water resources planning, and water development economics are reviewed. The major topics discussed are geography of Poland, climate, groundwaters and springs, rivers, lakes and reservoirs, water balance, and water economy. (Knapp-USGS) W69-08253

HYDROLOGY OF WETLAND FOREST WATERSHEDS,

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. For primary bibliographic entry see Field 04A. W69-08440

MULTIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON USING DATA OF KNOWN FUNCTIONAL RELATIONSHIP, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07B. W69-08499

SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, Forest Service (USDA), Berkeley, Calif. Pacific

Southwest Forest and Range Experiment Station. Henry W. Anderson, and James R. Wallis. US Dept Agr Misc Publ No 970 (1965): 22-30.

Descriptors: *Sediment discharge, *Reservoir silting, *Suspended load, *Erosion, Topography, Soil aggregation, Meteorology, Geology, Geomorphology, Road design, Watershed management, Ferest management, Channel morphology, Mountains, Analytical methods, Regression analysis, Oregon, California.

Identifiers: Sediment sources, Hydrologic potential, Rain-snow areas, Erodability.

Brings together results of 10 studies that show that between manageable units of watersheds, sediment yield (erosion) was found to vary by a factor of 36 with differences in runoff potential, by a factor of two with differences in topography, by a factor of five with differences in geologic stability, and by a factor of six to 18 with differences in land use and condition. Rain and snow melt frequencies by elevation zones and latitude are tabulated. Erodibility indices of soils developed on some 27 different rock types are given.

W69-08501

WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTEN-TIAL OF UNIT AREAS, Forest Service (USDA), Berkeley, Calif. Pacific

Forest Service (USDA), Berkeley, Calif. Pacifi-Southwest Forest and Range Experiment Station. Henry W. Anderson.

Proc (1965): 735-746. Pergamon Press - Oxford and New York - 1966.

Descriptors: *Hydrologic properties, *Environmental effects, *Analytical methods, *Statistical models, *Regression analysis, Watershed management, Snow cover, Snowmelt, Snow management, Sediment discharge, Mountains, Large watersheds, California, Mathematical models, Mathematical studies

Identifiers: Principal components analysis, Factor analysis, Logging (Timber).

The hydrologic potential of forest sites can be interpreted from analyses of watershed models and models of hydrologic processes. This concept is illustrated by a model relating sediment discharge from forty-six watersheds in northern California to watershed variables, and by a model relating snow accumulation at 163 snow courses to variables of terrain, including forest variables. Factor analysis is used in testing the adequacy of sampling of independent variables; principal component regression analyses are used in establishing physical relations to sediment and snow. Factor contributions after varimax rotation allows improved interpretation of explained variance. Application of a model in evaluating flood sources and the sediment potential of unit areas is illustrated.

IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD, FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION,

PRODUCTION,
Forest Service (USDA), Upper Darby, Pa.
Northeastern Forest Experiment Station; and
Forest Service (USDA), Berkeley, Calif. Pacific
Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 04D.
W69-08508

SOURCE AREAS OF STORM RUNOFF,

Tennessee Valley Authority, Knoxville. Roger P. Betson, and John B. Marius. Water Resources Res, Vol 5, No 3, p 574-582, June 1969. 9 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Storm runoff, Routing, Antecedent precipitation, Soils, Piezometers, Rain gages, Permeability, Infiltration, Runoff forecasting. Identifiers: Runoff source areas.

An investigation of runoff from a 4.64-acre agricultural watershed included the use of subplots, observation wells, and piezometers to determine the extent of source areas of storm runoff within the catchment. Studies of data collected showed that most of the storm runoff usually originates from a small portion of the total drainage area and that the location and extent of the source area is dependent upon rainfall intensity, antecedent moisture, and the depth of the A horizon soil. (Knapp-USGS) W69-08569

OPTIMAL IDENTIFICATION OF LUMPED WATERSHED MODELS,

California Univ., Los Angeles. John W. Labadie, and John A. Dracup. Water Resources Res, Vol 5, No 3, p 583-590, June 1969. 8 p, 3 fig, 1 tab, 9 ref.

Descriptors: *Mathematical models, *Rainfall-runoff relationships, *Computer programs, Linear programming, Optimization, Parametric hydrology, Digital computers, Computer models, Model studies.

Identifiers: Nonlinear rainfall-runoff models, Quasilinearization.

Though several investigators have noted the consistent nonlinearity of hydrologic system response to rainfall, nonlinear models have been avoided because of computation difficulties associated with the identification of model parameters from historic records. A few nonlinear models have been proposed, but the parameter identification methods lack generality and the capacity to deal

with complex models. Through quasi-linearization, implicit solutions to a large class of nonlinear models can be written in terms of a maximizing operation on linear equations. This algorithm also provides for systematic determination of the optimal values of model parameters in the identification problem. Furthermore, a complete set of accurate initial conditions need not be supplied. Application of quasi-linearization to a recent nonlinear conceptual model of watershed response displayed in particular (1) the simplicity of the computer programming through the use of standard subroutines and (2) the rapid convergence characteristics of the algorithm. (Knapp-USGS) W69-08570

SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY: RAINFALL AND PUNCEF

Universidad Nacional del Zulia, Maracaibo (Venezuela); and Geological Survey, Fort Collins, Colo.

Ignacio Rodriguez-Iturbe, and Carl F. Nordin. Water Resources Res, Vol 5, No 3, p 608-621, June 1969. 14 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Statistical methods, *Time series analysis, *Rainfall-runoff relationships, Correlation analysis, Frequency analysis, Regression analysis, Probability, Stochastic processes, Synthetic hydrology. Identifiers: Cross-spectral analysis.

Coherence and partial coherence between cyclic components of hydrologic time series show strong correlations among annual oscillations in precipitation and runoff for stations located in the Pacific Coast region of the United States. To distances of 1000 km the annual cycle of precipitation can be considered practically the same for all stations. Similar relations exist between records of streamflow, but the coherence is less because of variable watershed characteristics, evaporation, storage, and other factors influencing runoff. (Knapp-USGS)

PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTA-TIONS OF STREAMFLOW REGULATION, State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 07C. W69-08613

SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC SERIES, State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 07C. W69-08614

THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF REGULATION.

For primary bibliographic entry see Field 02E. W69-08626

PRINCIPLES OF HYDROLOGY,

Hull Univ. (England). Dept. of Geography. R. C. Ward.

Maidenhead, Berkshire, England, McGraw-Hill Publishing Co, Ltd, 1967. 403 p, 145 fig, 6 tab, 563 ref.

Descriptors: *Hydrology, *Surface waters, *Groundwater, Hydrologic cycle, Precipitation (Atmospheric), Interception, Evaporation, Evaporation, Soil moisture, Runoff, Rainfall-runoff relationships, Surface-groundwater relationships. Identifiers: Textbook.

Hydrology is discussed in a non-mathematical manner in a comprehensive general textbook for engineers which should also be of use to others, including water managers, students, and the laymen with a good basic scientific background. Numerous field examples from the British Isles are given. An effort is made to keep engineering and other applied aspects of hydrology to a minimum, so that the discussion may be as close to 'pure' hydrology as possible in a basically applied science. Basic top-ics covered in detail include the hydrologic cycle, precipitation, interception, evaporation, evaporanspiration, soil moisture, groundwater, and runoff. A bibliography is included at the end of each chapter. (Knapp-USGS) W69-08628

2B. Precipitation

HEAT BALANCE STUDIES DURING AN ICE-FOG PERIOD IN FAIRBANKS, ALASKA, Alaska Univ., College. Geophysical Inst.

For primary bibliographic entry see Field 02C. W69-08198

COMPARISON BETWEEN RAIN GAGE AND LYSIMETER MEASUREMENTS.
California Univ., Davis. Dept. of Water Science

and Engineering.
D. L. Morgan, and F. J. Lourence

Water Resources Res, Vol 5, No 3, pp 724-728, June 1969. 5 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Rain gages, *Lysimeters, *Instrumentation, Rainfall, Wind, Precipitation (Atmospheric), Calibrations, On-site tests, Quality control, Sampling. Identifiers: Central Valley (Calif).

Rain-gage data were compared with ground-level precipitation as determined with a highly sensitive lysimeter 20 ft in diameter. Rain gages of various types were tested in the Central Valley of California during 24 storms in the 1966-1968 rainfall seasons. Rainfall totals for each storm as measured by the lysimeter and by several rain gages in its vicinity were compared by regression analysis. Wind effects on a standing gage seemed unimportant, since agreement was close between a standard 8-inch rain gage mounted in the normal standing position and a USSR 3000-sq-cm rain gage mounted at ground level. Storm totals from these 2 gages spaced about 10 ft apart averaged 4% higher than catches measured 450 ft away by the lysimeter and a Fischer and Porter digitizing rain gage spaced about 10 ft apart. Fischer and Porter gage storm catch values varied generally about the mean value of the lysimeter data. The coinciding means of all of the data from these 2 instruments suggest that wind effects compensate over the period of storms studied. (Knapp-USGS) W69-08208

GEOMORPHOLOGY,

Heidelberg Univ. (West Germany); and Univer-sitaet des Saarlandes, Saarbruecken (West Germany)

Fritz Machatschek. Edited by H. Graul and C. Rathjens. New York, Amer Elsevier Publ Co, Inc, 1969. 9th Engl edition. 212 p, 87 fig, 736 ref.

Descriptors: *Geomorphology, *Land forming, *Climatology, Environmental effects, Erosion, Geologic control, Glaciers, Structural geology, Topography, Weathering, Soil formation, Bibliographies. Identifiers: Textbooks.

An English translation of a standard German geomorphology test is presented as an introduction to the subject for the serious student. The bibliography is extensive, and particularly complete in references to German and French work. The effects of various climates on tectonic landforms is stressed. The topics discussed include orogeny, epeirogenic movements, volcanism, earthquakes, weathering, soil formation, mass movements, flu-viatile landforms, major landform types, climatic

differentiation of landforms, humid climate landforms, glacial landforms, arid climate landforms, coastal landforms, and anthropogenic effects. (Knapp-USGS) W69-08226

A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND VOLUMES OF PRECIPITATION, CALCULATE

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 07C. W69-08238

COMPUTATIONAL ANALYSES OF MOISTURE FLUX OVER NORTH AMERICA,

Travelers Research Center, Inc., Hartford, Conn. J. G. Welsh, H. M. Frazier, and P. Boch. Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 307-316, 1968. 10 p.

3 fig, 2 tab, 27 ref.

Descriptors: *Meteorology, *Data processing, *Digital computers, *Weather forecasting, *Digital computers, Hydrologic budget, Heat flow, Mass transfer, Computer programs, Atmospheric physics, Air masses, Distribution patterns, Evaporation, Humidity, Synoptic analysis.

Identifiers: Flux divergence, Moisture flux.

Terrestrial water budgets may be evaluated by balancing horizontal and vertical transfers of water into and out of the air space above a given drainage basin. Such hydrometeorological studies have been performed for the 5-year period May 1958-April 1963, for the North American region using highspeed electronic data processing machines to perform the analyses. The generation of vertically integrated moisture and moisture transport statistics for some 176 North American stations are described for each of the 60 months based on meterological statistics at each of 16 levels in the atmosphere from the surface to 300 millibars. Covariances were computed for wind components and specific humidity data for each day of the 5 years for each station, then summed and analyzed to yield 89 time-averaged fields (maps) of flux divergence of moisture over North America, and other maps of velocity potential, streamlines, and zonal and meridional transport terms. The complex of computer programs to perform these analyses is described. The resulting inventory of moisture flux data over North America represents the most complete analysis to date of the atmospheric limb of the hydrologic cycle. (Knapp-USGS) W69-08244

VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE SOUTHWEST, Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.

Herbert B. Osborn.

5th Proceed, Conference on Severe Local Storms, Amer Meteorological Society, St Louis, Mo, pp 219-225, October, 1967. 7 p, 7 fig, 2 ref.

*Variability, *Thunderstorms, *Southwest U.S., Arid lands, Arizona, Acreage, Areal, New Mexico, Demonstration Arizona. watersheds, Rainfall disposition, Small watersheds, Hail, Isohyets, Precipitation intensity, Rain, Weather patterns, Storm runoff.

Identifiers: Alamogordo Creek watershed, Walnut Gulch watershed.

Eleven years of records from dense networks of recording rain gages on 67 sq. mi. Alamogordo Creek watershed (N.M.) and 58 sq. mi. Walnut Gulch watershed (Ariz.) are indicative of thunderstorm patterns in the arid Southwest. Point intensities for 5 min. periods sometimes approached 10 in/hr. on the Walnut Gulch watershed, while on Alamogordo Creek they have exceeded 15 in/hr. Two exceptional storms at Alamogordo Creek produced over 3 in. of precipitation in 15 min. On the Walnut Gulch watershed, the runoff-producing

portion of most thunderstorms lasted for less than 15 min. and covered less than 5 sq. mi. 90% of all thunderstorms lasted less than 30 min. Only with intense networks of rain gages is it possible to accurately measure the frequencies of thunderstorms of varying magnitudes and durations on 60 sq. mi. watersheds and on the semiarid rangelands of the Southwest. (Sherbrooke-Ariz) W69-08309

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,

Vanderbilt Univ., Nashville, Tenn.; Office of the Surgeon General (Army) (South Vietnam); and Johns Hopkins Univ., Baltimore, Md. For primary bibliographic entry see Field 01A. W69-08417

THE GENERATION OF SPRING PEAK FLOWS SHORT-TERM METEOROLOGICAL EVENTS.

Forest Service (USDA), Moscow, Idaho. Forestry Sciences Lab.

For primary bibliographic entry see Field 02C. W69-08435

EFFECTS OF HURRICANE STORMS ON AGRICULTURE,

Colorado State Univ., Fort Collins. L. M. Hartman, David Holland, and Marvin

Giddings. Water Resources Res, Vol 5, No 3, pp 555-562, June 1969. 8 p, 3 tab, 22 ref.

Descriptors: *Hurricanes, *Damages, *Crop production, Catch crops, Economics, Winds, Rainfall, Infiltration, Runoff, Erosion, Statistical methods, Regression analysis, Storms. Identifiers: Hurricane effects on agriculture.

Hurricane storms as they move inland are accompanied by rather widespread rainfall. The effect of the rainfall on crop production depends upon the time occurrence of the storm. A statistical time series analysis of the relation between rainfall by time periods and crop yields indicates that rainfall during the major hurricane season (August, September, and October) is damaging to many crops. The analysis consisted of a multiple regression of crop yields on rainfall by 10-day time intervals. The total benefit or loss from any storm would depend upon the time occurrence and the track of the storm. A summary of change by states in total crop value from 1 inch of incremental rainfall for their 5 major crops resulted in both positive and negative totals, depending upon the time period. Predicted changes in yield and crop value for 3 historic storms indicate net losses for 2 storms occurring in August and September and net benefits for 1 storm occurring in July. (Kanpp-USGS) W69-08568

PRECIPITATION IN NORTHERN QUEBEC AND LABRADOR: AN EVALUATION OF MEASUREMENT TECHNIQUES, Department of Transport, Toronto (Ontario).

Meteorological Branch.

Br. F. Findlay. Arctic, Vol 22, No 2, pp 140-150, June 1969. 11 p, 4 fig, 2 tab, 18 ref.

Descriptors: *Precipitation (Atmospheric), *Precipitation gages, *Arctic, *Cold regions, *Measurement, Calibrations, Snow, Rain, Winds, Hydrologic Budget, Synoptic analysis, Snow surveys, Gaging stations, Interception, Evapotrans-

Identifiers: Quebec, Labrador, Canada.

A testing of published maps of precipitation normals for a continental subarctic area using hydrological techniques suggests a systematic annual error of 6 inches (152 mm.). The scope of the analysis is subcontinental, but point values for a central climatological station are used to elucidate

Field 02-WATER CYCLE

Group 2B—Precipitation

indirect techniques available for the adjustment of precipitation gage data. These methods include snow surveying, stream gaging, interception and evapotranspiration calculations and watershed rain gage networks. All hydrological parameters are characterized by inherent errors in measurement and short periods of record. Consequently, the results of this investigation should be considered speculative. (Knapp-USGS) W69-08587

2C. Snow, Ice, and Frost

HEAT BALANCE STUDIES DURING AN ICE-FOG PERIOD IN FAIRBANKS, ALASKA,

Alaska Univ., College. Geophysical Inst. Gerd Wendler.

Mon Weather Rev, Vol 97, No 7, pp 512-520, July 1969. 9 p, 9 fig, 2 tab, 21 ref.

Descriptors: *Fog, *Alaska, *Ice, *Heat balance, Solar radiation, Heat budget, Weather, Climates, Smar Air rollytics offerts Condensation Smog, Air pollution effects, Condensation. Identifiers: *Ice fog, Fairbanks (Alaska).

Ice fog, which is in a way similar to a dense cirrostratus cloud near the surface, occurs in Fairbanks when the temperature drops below -35 deg. C. The heat balance of two stations, one below the ice fog in the valley and the other one on Birch Hill above the ice fog, are compared for the longest cold spell in winter 1966/67. The valley station shows a rela-tively small radiative loss of 47 cal per sq cm per day, as the ice fog shelters the surface against a highly negative long-wave radiation balance. The energy for compensation of this loss comes mostly 25 cal per sq cm per day out of the soil. On Birch Hill the radiative loss (124 cal per sq cm per day) is nearly three times larger, mostly due to the smaller amount of the incoming long-wave radiation, and here the sensible heat flux (102 cal per sq cm per day) provides most of the energy. (Knapp-USGS) W69-08198

A SIMPLE SNOWMELT LYSIMETER,

Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station. Harold F. Haupt.

Water Resources Res, Vol 5, No 3, pp 714-718, June 1969. 5 p, 1 tab, 7 ref.

Descriptors: *Snow, *Lysimeters, *Snowmelt, Instrumentation, Snow cover, Snowfall, Snow management, Streamflow forecasting, Runoff forecasting. Identifiers: *Snow gages.

A simple-gage on the lysimeter principle has been developed to provide continuous readings of the volume of water flowing from the base of a snow-pack in the form of surface melt alone or rain percolate and surface melt combined. The data obtained show promise, after two seasons, of being applicable in river flood forecasting, as well as in studies of snow hydrology. (Knapp-USGS)

SNOW ACCUMULATION ON MOUNT LOGAN. YUKON TERRITORY, CANADA.

Cold Regions Research and Engineering Lab., Hanover, N. H.

C. M. Keeler.

Water Resources Res, Vol 5, No 3, pp 719-723, June 1969. 5 p, 4 fig, 1 tab, 10 ref.

Descriptors: *Snowfall, *Cold regions, *Mountains, Topography, Snow surveys, Elevation, Orography, Meteorology.

Identifiers: *Mt. Logan (Canada), Yukon Territory

Measurement of snow accumulation for the year from summer 1967 to summer 1968 on Mt. Logan, St. Elias Mountains, Yukon Territory, Canada, indicates that annual precipitation is approximately 0.65 meters per year for elevations between 3350 and 5400 meters. This is less by a factor of 5 than annual precipitation at sea level on the Gulf of Alaska. On a regional basis precipitation decreases inland from the Pacific Ocean at a rate of approximately 0.00002 meters per km. Precipitation decreases on the windward and increases on the leeward sides of the St. Elias Mountains with respect to elevation. (Knapp-USGS) W69-08207

GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL FOR FIELD AND OFFICE WORK,

Department of Energy, Mines and Resources, Ottawa (Ontario); and Norwegian Water Resources Board, Oslo.

G. Ostrem, and A. Stanley.

Can Dep Energy, Mines and Resources and Norwegian Water Resources and Elec Board Rep, 1969. 127 p, 20 fig, 25 photo, 7 tab, 55 ref.

Descriptors: *Glaciers, *Surveys, *Regimen, Movement, Glaciation, Melting, Suspended load, Scour, Climatic data, Ablation, Snowfall, Melt water, Data collections, Investigations, Mapping, Measurement, Profiles, Surveying instruments, Climatology, Discharge (Water).
Identifiers: *Glaciology, Glaciological field work

manual.

Field procedures used by the Canadian Department of Energy, Mines, and Resources and the Norwegian Water Resources and Electricity Board to collect glacial mass-balance data are described in a field manual. The manual describes standard field techniques, outlines practical difficulties and their solutions, gives practical field work hints, and suggests methods of recording, tabulating, and plotting data. Topics discussed include stake networks, accumulation measurements, ablation measurements, plotting and contouring, meteorological observation, water discharge measurements, suspended load measurement, surveying, field camp accomodations, field organization, and office procedures. An extensive bibliography is given. (K-napp-USGS) W69-08227

HEAT BUDGET OF AN ICE COVERED INLAND

Wisconsin Univ., Madison. Dept. of Meteorology. For primary bibliographic entry see Field 02H. W69-08404

THE GENERATION OF SPRING PEAK FLOWS SHORT-TERM METEOROLOGICAL EVENTS,

Forest Service (USDA), Moscow, Idaho. Forestry Sciences Lab. Harold F. Haupt.

Bulletin of the Int. Assoc. of Scientific Hydrology, 1968. 13 (4): 65-76, Illus.

Descriptors: *Peak discharge, *Meteorology, *Rainfall intensity, *Snowmelt, Watersheds (Basins), Streamflow, Snowpacks, Storm runoff, Melt water.

Identifiers: Priest River Experimental Forest, Hydrometeorology.

Spring peak flows recorded over a 25-year period in Benton Creek, a small forested watershed (1.5 mi2) in northern Idaho, were studied in relation to meteorological events. The analysis revealed: (1) Slightly more than one-half of the spring peaks (56 percent) were associated with rain-on-snow events; less than one-half (44 percent) were associated with snowmelt events; (2) the timing of maximum spring discharge for years of rain-on-snow peaks was more closely synchronized with the ending day of maximum rainfall than it was for years of snowmelt peaks with the ending day of maximum temperatures; (3) in some years, heavy rainfall accompanied by relatively high air temperatures affected the generation of spring peak runoff, whereas in other years, heavy rainfall had a strong suppressing effect on air temperature so that snowmelt con-

tribution to runoff was probably less and peak volumes did not occur; and (4) the highest peak runoff of record was a snowmelt event. W69-08435

SNOW CATCH BY CONIFER CROWNS,

Forest Service (USDA), Moscow, Idaho. Forestry Sciences Lab.

Donald R. Satterlund, and Harold F. Haupt. Water Resources Research, 1967, 3 (4): 1035-

Descriptors: *Interception, *Snow, *Coniferous trees, *Idaho, Water loss, Mathematical models,

Identifiers: Priest River Experimental Forest, Interception storage.

Study of interception storage of snow by two species of sapling conifers in northern Idaho revealed that cumulative snow catch follows a classical law of autokinetic growth, or I(s) = S/(1+e) to the -K (P-P (0))power) where I(s) is interception storage, S is the interception storage capacity of the tree, e is the base of the natural logarithm, k is a constant expressing the rate of interception storage, P is accumulated snowfall, and P (o) is accumulated snowfall at the time of most rapid storage (i.e., the point of inflection of the sigmoid curve). Interception storage conformed to the law in five storms in which snowfall began while the trees were bare, and in two storms in which snow fell while snow from previous storms persisted on the trees. Several small storms yielded insufficient data to define the appropriate constants, but inspection indicated no serious deviation from the general law. W69-08436

AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS AND FUTURE PROSPECTS,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. M. Martinelli, Jr.

Weatherwise, Vol 19, No 6, p 232-239, Dec 1966. 7 p, 9 fig.

Descriptors: *Avalanches, Structures, Instrumentation, Meteorology, *Snowpacks, Control structures, *Snow management, Explosions.

Identifiers: Avalanche hazard evaluation, Avalanche forecasting, Avalanche control, Sup-porting structures, Avalanche control structures, Avalanche research, *Snow avalanches.

Research carried out in 1930 in Switzerland formed the scientific basis of avalanche hazard evaluation from weather factors and avalanche control using structures and vegetation. Some types of avalanche control structures are used to prevent avalanches from starting; other types protect valuable property or confine or restrict avalanche motion. The intentional release of avalanches by explosion is another type of avalanche control. Avalanche motion studies have been carried out in Europe and Japan. European studies are based on hydraulic principles; Japanese on experimental tests and measurements. Avalanche classification and avalanche hazard evaluation are still highly subjective. Research on these and other avalanche topics is underway in many countries. (Martinelli-USDA Forest Service) W69-08444

SNOW AVALANCHES ALONG COLORADO MOUNTAIN HIGHWAYS, Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. Hans Frutiger.

USDA, Forest Service Res Paper RM-7, Jul 1964. 85 p, 3 fig, 1 tab.

Descriptors: *Avalanches, Colorado, Highways, Control structures, Explosions, *Snowpacks, *Snow management.

Identifiers: Avalanche paths, Avalanche control, Avalanche classification.

The avalanche paths along four mountain passes in central Colorado are named illustrators and described in detail. The most appropriate method for controlling each avalanche is outlined on the basis of available records and field investigations. (Martinelli-USDA Forest Service) W69-08445

SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN UNITED STATES,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Arthur Judson.

Physics of Snow and Ice, Proc International Conference on Low Temperature Science 1966, Vol 1, Part 2, p 1151-1168, 1967. 9 fig, 1 tab, 6 ref.

Descriptors: *Avalanches, *Snow cover, *Snow-fall, Climatic data, Alpine, Rocky Mountain Re-gion, Weather, Precipitation (Atmospheric), Crystals, Snowpacks, Snow management.

Identifiers: Colorado, Slab avalanches, Snow cover stratigraphy, Avalanche hazard forecasting, Snow profiles, Avalanche fatalities.

Based on 17 years of alpine snow and avalanche records from a high mountain pass in Colorado representative of conditions in the High Alpine Zone of Western United States Characteristics are given for 80 avalanche tracks in Colorado. 80% of all avalanches were slab avalanches and soft slabs were most frequent. Bimonthly snow cover data, from pits in a level test field in the timber, includes: grain shape, grain size, snow temperatures, temperature gradients, density, and hardness in each layer. Means and extremes of these parameters are discussed, and a comparison is made of test field pits with profiles from five adjacent avalanche sites. The depth, grain shape, and strength of the snow in the lowest layer at the test field was similar to that in nearby avalanche starting zones. Greatest difference was found in the strength and thickness of the middle layers of the pack. This attributed to wind action at the avalanche sites. Discusses avalanche hazard forecasting with reference to the use of snowpits and weather data in the High Alpine Zone; outlines the use of precipitation data to determine when to start avalanche control during major storms. (Martinelli-USDA Forest Service) W69-08446

A MANUAL FOR PLANNING STRUCTURAL

CONTROL OF AVALANCHES, Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Hans Frutiger, and M. Martinelli, Jr. USDA, Forest Service Res Paper RM-19, May 1966. 68 p. 37 fig, 3 tab, 38 ref.

Descriptors: *Avalanches, Structures, Meteorology, *Control structures, *Snowpacks, *Snow management.

Identifiers: Avalanche structures, Avalanche control. Case history.

Avalanche classification for control purposes should include frequency of occurrence and whether dry or wet avalanches are most common. Avalanche areas consist of a catchment basin with one or more starting zones, the track and runout zone. Structural control of avalanches started in Switzerland over a century ago. Early structures were built from materials at the site; earthen mounds and dams or wooden barriers. Modern structures utilize concrete, steel, aluminum as well as wood and earth. Supporting structures in the starting zone must be designed to withstand creep and glide pressures; the empirical means of doing so are given in formulae and nomographs. Snow drift control and diversion and retarding structures can also be used under certain stipulated conditions. The field information necessary for planning avalanche control installations is outlined and a

case example is presented. (Martinelli-USDA Forest Service) W69-08447

THE WEATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Arthur Judson.

USDA, Forest Service Res Paper RM-16, Nov 1965. 28 p, 26 fig, 15 tab.

Descriptors: *Snowfall, *Snow cover, *Air temperature, *Winds, Wind velocity, Climatic data, Weather data, Storms, Meteorology, Rocky Mountain Region, *Avalanches, Snowpacks.
Identifiers: Mountain meteorology, Alpine areas,

Colorado, Return periods.

Presents information basic to mountain meteorology and avalanche-control planning from Berthoud Pass--an area representative of Colorado's avalanche zones near timberline. Describes and illustrates wind, temperature, snowfall, snow depth, rainfall, and related weather patterns from data collected irregularly 1926-49, continuously since then. Compares direction and windspeeds at surface at Berthoud Pass with 4,000 m. winds over Denver and Grand Junction. Analyzes weather relationships of 10 large winter storms at the Pass. (Martinelli-USDA Forest Service) W69-08448

EXAMPLE OF DAMAGE FROM A

POWDER AVALANCHE,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
M. Martinelli, Jr., and K. D. Davidson.
Bulletin of International Association of Scientific
Hydrology, XI (e) Annee No 3 pp 26-34, 1966. 9 p,

Descriptors: *Avalanches, *Snowpacks, *Atmospheric physics, *Velocity, Equations. Airblast. Identifiers: Powder avalanches, Avalanche accident, Avalanche damage, *Snow

A powder avalanche moved a 3,200 kg truck 19.8 m horizontally and dropped it 15.2 m into a gully without serious damage. Data from the site are used to compute the velocity of snow-free air and of a snow-air mixture necessary to cause this event. These velocities are found to be within the velocity of the avalanche as estimated from the equations published by A. Voellmy. (Martinelli-USDA Forest W69-08449

INFLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SNOW FENCE ON SIZE AND LOCATION OF LEE DRIFT,
Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. M. Martinelli, Jr.

Bulletin of the International Association of Scientific Hydrology, IX (e) Annee No 4, pp 48-57, 1964. 10 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Snow, *Snow management, *Snow-packs, Structures, Control structures, Meteorolo-

Identifiers: Snow fences, Snow accumulation, Snow

When vertical slat snow fences were built with gaps of 1, 2, and 4 feet below 6 feet of fencing, maximum snow depth and maximum snow volumes were found in the lee drifts behind the fences with the 1-foot gap. As gap size increased, maximum snow depth moved farther from the fence and decreased. The volume of snow in the lee drifts behind fences with 2- and 4-foot was about the same, but amounted to only a little over one-half that behind fences with 1-foot gaps. The 1-foot gap

became plugged with snow even in the belowaverage snow year studied. This caused maximum snow depths to move toward the fence. (Martinelli-USDA Forest Service) W69-08450

SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW COVER, Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. James D. Bergen.

Rcoky Mountain Forest and Range Experiment Station, USDA Forest Service Research Note RM-110, 1968. 7 p, 4 fig, 4 ref.

Descriptors: *Snow, *Snow cover, *Thermal stratification, *Climatology, Mountain forests, Heat transfer, *Density stratification, Temperature, Snow surveys, Microenvironment, Cold resistance.

Measurements of the vertical temperature distribution in an annual mountain snow cover are discussed in terms of a simple model of the vertical temperature profile. The parameters describing this model are compared for measurements made for 2 winters. Day-to-day variation is found to be larger for these parameters than between different months of the same winter or between the 2 win-

W69-08451

ATMOSPHERIC HUMIDITY MEASUREMENT

NEAR THE SNOW SURFACE, Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.

James D. Bergen. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service Research Note RM-116, 1968. 4 p, 3 fig, 5 ref.

Descriptors: *Hygrometry, *Boundary layers, *Snow cover, Humidity, Microenvironment, Moisture content, Boundary processes, Evaporation, Latent heat, Vapor pressure, Sublimation. Identifiers: Bowen ratio.

Describes a technique for measuring atmospheric humidity in the first few centimeters over a snow cover. Results are presented for four observation periods. The water vapor density at a nominal reference level of 2 cm above the snow surface was found to vary from less than 20 percent to 90 percent of the density corresponding to saturation at the snow surface temperature. Little diurnal variation was found for the Bowen ratio. Possible remedies for difficulties encountered in the measurements are described. W69-08452

SOME MEASUREMENTS OF AIR PERMEA-BILITY IN A MOUNTAIN SNOW COVER, Forest Service (USDA), Fort Collins, Colo. Rocky

Mountain Forest and Range Experiment Station. James D. Bergen.

Bulletin of the International Association of Scientific Hydrology, XIII (e) Annee No 3, pp 5-13,

Descriptors: *Snow, *Snow cover, *Snowpacks, *Physics, *Permeability, Mass transfer, Air, Flow resistance, Porous media, Mountain forests, Snow surveys. Sublimation. Identifiers: *Snow metamorphosis.

Air permeability and density at various levels in an annual mountain snow cover were measured on three separate days in mid-February, early March, and late March, respectively. Permeabilities are presented together with estimates of grain size based on the empirical correlations between grain size and air permeability found in the literature. The variation of air permeability with absolute porosity for various snow types is compared with that found in the literature for a Swiss alpine snow cover and found to be in fair agreement. Grain size

Field 02-WATER CYCLE

Group 2C—Snow, Ice, and Frost

in the depth hoar layer is found to decrease by a third over the last period. W69-08453

AREAL EXTENT OF SNOW COVER IN RELA-TION TO STREAMFLOW IN CENTRAL COLORADO,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Charles F. Leaf.

Int Hydrol Symp Proc, 1967 (vol 1): 157-164 illus.

Descriptors: *Aerial photography, *Runoff forecasting, *Snow cover, *Streamflow forecasting, Flood forecasting, Forecasting, Model studies, *Aerial photography, Photogrammetry, Remote sensing, Snowmelt, Snowpacks, Snow surveys, Terrain analysis, Simulation analysis

Identifiers: *Snow-cover depletion, Areal snow

Aerial photography indicates that snow depletion rates are highly correlated with seasonally generated runoff volumes. Patterns of snow depletion and generated runoff have been consistent from year to year, even though the amount of snow and weather conditions which produced runoff were not the same. W69-08454

PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULA-TION PROJECTS.

Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B.

A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK

INSTRUMENT FOR TEMPERATURES,
Forest Service (USDA), Tempe, Ariz. Rocky
Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B. W69-08469

OBSERVATIONS OF SNOWPACK ACCUMU-LATION, MELT, AND RUNOFF ON A SMALL ARIZONA WATERSHED, Forest Service (USDA), Flagstaff, Ariz. Rocky

Mountain Forest and Range Experiment Station.

For primary bibliographic entry see Field 03B. W69-08493

OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEMONSTRATION CUTTINGS PONDEROSA PINE IN CENTRAL ARIZONA,

Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08494

USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED MANAGEMENT, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07B. W69-08496

MANAGING CALIFORNIA'S SNOW ZONE

LANDS FOR WATER, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08498

SNOW ACCUMULATION AND MELT IN RELA-TION TO TERRAIN IN WET AND DRY YEARS, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Henry W. Anderson, and Allan J. West. 33rd Ann Western Snow Conf, Proc (1965): 73-82.

Descriptors: *Snow cover, *Snowmelt, *Environmental effects, Topography, Elevation, Slope, Analytical techniques, Regression, Coniferous forests, Mountains, California, Snowpacks. Identifiers: *Forest openings, *Principal components analysis.

To determine terrain-snow relations three years with wide differences in snow accumulation and melt,-1958, 1959, and 1960, and snow water equivalent on March 1, April 1, and May 1 in each of those years were analysed separately by regression on principal components. Terrain effects on snow were expressed in two parts: first, the mesoterrain, representing the surroundings within a few hundred or thousands of feet around the course; and second, the local terrain at the snow course Snow differences with elevation become greater as the season progresses from March 1 to May 1, especially in dry years. One implication is that snow sensors, such as snow pillows or radioactive snow gages, at a single elevation cannot index snow at all elevations in different years. For snow courses in forest openings, the width of the openings had more effect in the year of heavy snowfall than in the dry years. In the wet year, 1958 snow was 3 to 3 1/2 inches greater in an opening 4 tree heights across than in an opening only one tree height across; however, in dry years 1959 to 1960 the differences averaged less than one inch. Cold air drainage obviously plays a role in delaying snowmelt in openings as well as in the forest adjacent to openings. The increase in snow in the downhill half of openings as contrasted to the uphill ranged from 3 to 5.5 in.; in the adjacent forest the downhill portions had 2 to 3.5 inches more, with differences increasing with season (March 1 to May 1). W69-08500

INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08503

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, Forest Service (USDA), Berkeley, Calif. Pacific

Southwest Forest and Range Experiment Station. Henry W. Anderson. Int Ass Sci Hydrology Publ No 78 (1967): 215-224.

Descriptors: *Snow cover, *Snow management, *Snow fall, *Interception, *Snowpacks, Cloud cover, Advection, Heat budget, Humidity, Solar radiation, Topography, Mountain forests, Watershed management, Analytical techniques,

Identifiers: Forest patterns, Forest canopy, Snow distribution, Principal components analysis.

Snow accumulation at individual points in forest and openings in forests was studied by selecting 16 periods in the winter of 1957-58 under different meteorological conditions. Wide differences in topography and forest conditions were obtained by selection of 250 points from 1,300 available. Snow accumulation was the difference in water equivalent of the snow pack between measure-ments. Meteorological variables included functions of clouds, wind, humidity, temperature, and precipitation. Forest variables included indexes of shade, back radiation, interception, cold air drainage, and shelter from the wind. Topography was expressed in terms of solar energy received and exposure to prevailing winds. The factors related to snow accumulation were studied by reduced rank procedure of principal components, principal axis, canonical, and alpha factoring with varimax rotation of the factors. The best regressions relating the variables to snow accumulation arose from principal components analysis when highly correlated variables were included. Snow accumulation de-

pended strongly on combinations of meteorological and forest variables, and on forest-meteorological interactions. Interception of snow, as indexed by the canopy over the point, averaged 10 percent of the precipitation. Snow accumulation in forest openings, forest margins, and in large areas of uniform forest had different relations to meteorlogical and topographic variables. Forest shade and back radiation from trees were most important on high energy south slopes. W69-08506

GLACIAL AND FLUVIO-GLACIAL FORMATIONS OF THE LYON REGION (FRENCH), Lyon Univ. (France). Dept. of Earth Sciences.

L. David.

Doc Lab Geol Fac Sci, Lyon, No 22, 1967. 159 p, 37 fig, 23 plate, 56 ref.

Descriptors: *Glaciers, *Sediments topography, Geology, Alluvium, Geomorphology, Mud, Loe Sands, Gravels, Canals, Streamflow, Maps, Wells. Identifiers: *France, Lyon region, Glacier deposits.

Glacier deposits of the Lyon region, France, were investigated on the basis of earlier publications. The monogram contains the following chapters: (1) general considerations; (2) external domain; (3) intermediate domain; (4) interior domain (natural of alluvium deposits, morphology, radial hills ravines); (5) some general problems; and (6) conclusions. The result of this detailed investigation is a much better understanding of the geological history of the Lyon region during its period glaciation, although this period is limited in time and space. (Gabriel-USGS)
W69-08627

2D. Evaporation and Transpiration

WATER YIELD CHANGES AFTER CONVERT-ING A FORESTED CATCHMENT TO GRASS,
Forest Service (USDA), Tempe, Ariz. Forest

Hydrology Lab.

For primary bibliographic entry see Field 03B. W69-08200

ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, California Univ., Davis

David C. Davenport, Robert M. Hagan, and Paul E.

Water Resources Res, Vol 5, No 3, pp 735-743, June 1969. 9 p, 4 fig, 1 tab, 33 ref.

Descriptors: *Transpiration control, *Water conservation, Chemcontrol, Stomata, Water yield, Water management (Applied), Watershed management. Identifiers: *Antitranspirants.

Research on antitranspirants may have application in increasing the yield of water from watersheds by reducing transpirational losses from vegetation under certain environmental conditions. There are 3 broad groups of antitranspirants: (1) reflecting materials that decrease the heat load on the leaf, (2) film-forming materials that hinder the escape of water vapor from the leaf, and (3) stomata-closing materials that increase stomatal resistance. Antitranspirants are most effective in decreasing transpiration when other resistances in the passage of water to the roots, through the plant, and to the atmosphere are not great, when there is good coverage of the stomatal bearing leaf surfaces (except for reflecting materials), when new foliar growth following treatment is minimal, and when optimum concentrations and application rates are used. (Knapp-USGS) W69-08210

COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL MOISTURE IN WATER EFFICIENCY STUDIES,

Arizona Univ., Tucson. Dept. of Agronomy. A. K. Dobrenz, D. F. Cole, and R. J. Joy.

Agronomy Journ, Vol 60, p 446, July-Aug, 1968. 1 p. 1 fig. 6 ref.

Descriptors: *Evaporation control, Soil sealants, Surface sealing, Arid climates, Perlite, Growth chambers, Soil-water-plant relationships, Southwest U.S.

Identifiers: *Water efficiency studies, *Styrofoam, Vermiculite, Pea gravel, 20-mesh sand.

This study tested the ability of several materials to reduce evaporation of soil moisture from 4.2 liter size cans in which multi-stemmed, tillering plants were being tested for water efficiency in a growth chamber programmed for environmental conditions of the southwestern U.S. Coarse styrofoam reduced evaporation by 78%, which was significantly greater than the other six materials (fine styrofoam, pea gravel, 20-mesh sand, perlite, versettle, and bece soil). Coarse styrofoam is program is program in the coarse styrofoam is program in the program program in the program in the program is program in the program in the program in the program is program in the program in the program in the program is program in the program in the program in the program is program in the program in the program in the program in the program is program in the program i miculite and bare soil). Coarse styrofoam is non-toxic, permeable, light weight, and easy to apply. (Sherbrooke-Ariz) W69-08292

POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN WESTERN STATES WITH EMPHASIS ON CALIFORNIA,

California Univ., Davis. Dept. of Botany

Amer Assoc Advance Sci Publ 86, 93-126, 1967. 34 p, 14 fig, 7 tab, 46 ref.

Descriptors: *Climatic zones, *Vegetation, Evapotranspiration, California, Arid climates, Deserts, Semi-arid climates, Coasts, Climatic data, Distribution patterns, Water balance, Moisture availability, Great Basin.

Identifiers: *Potential evapotranspiration, *Far

Western States, Sierran vegetation, San Joaquin Valley.

Several types of Far Western vegetation (coastal vegetation, Central Valley vegetation, Sierran vegetation, Northern Great Basin vegetation and Southern Desert vegetation) are correlated with climatic factors such as water deficit, water surplus, actual evapotranspiration and potential evapotranspiration. The data emphasize the climatic diversity of the terrain occupied by many plant formations rather than the reverse. There is no one to one correspondence between climates and vegetation types in the Western states. Of the 29 broad vegetation types suggested by Kunz and Keck as making up California's vegetation, at least a third occur in the same regional climate as another quite different type. Therefore, these are not primarily climatically determined. (Sherbrooke-Ariz) W69-08308

POTENTIAL EVAPOTRANSPIRATION HUMID AND ARID CLIMATES,

Missouri Univ., Columbia. Dept. of Soils.

Wayne L. Decker.

Proceed, Conference on Evapotranspiration and its Role in Water Management, Amer Soc Agric Engineers, Chicago, p 23-26, 4 fig, 1 tab, 11 ref 1966. 4 p. OWRR 14-01-0001-838.

Descriptors: *Evapotranspiration, *Arid climates, *Humid climates, Elevation, Latitudinal studies, Climatic data, Energy budget, Heat balance, Irrigation effects.

This paper evaluates the concept of potential evapotranspiration and its relationship to various climatic conditions. Attempts at measuring potential evapotranspiration from a growing plant canopy are valid only when water is abundant and canopy are valid only when water is additional and unlimited in the soil profile. Estimations of evapotranspiration potential from mean temperature and energy budget data are discussed. In semiarid and arid regions the actual evapotranspiration is determined by the amount of precipitation is determined by the amount of precipitation. tion. Analysis shows that use of a method for estimating potential evapotranspiration based on the mean temperature will result in no great difference between the moist and the dry climates at similar

latitudes and elevation. Movement toward warmer or cooler climates results in rapid changes of potential evapotranspiration. When high levels of soil moisture are maintained through irrigation, the actual evapotranspiration is nearly equal to the potential evapotranspiration. Potential evapotranspiration is discussed in relation to irrigation problems. (Sherbrooke-Ariz) W69-08310

WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.

M. T. Chang, and R. Lee.

Institute for Research on Land and Water Resources, Research Project Technical Comple-tion Report, University Park, Pa., June 1969. 101 p, 24 fig, 24 tab, 54 ref. OWRR A-012-PA.

Descriptors: *Phenology, *Evapotranspiration, Temperature, Climatology, Energy buc Hydrologic budget, Water yield, Transpiration. Identifiers: *Temperature measurement, *Pallmann method, Thornthwaite method, Central Pennsylvania.

The Pallmann method of temperature sensing was to obtain space- and time-integrated air temperatures on a 303-acre experimental, forested watershed in central Pennsylvania. The method proved to be a highly sensitive, effective, and economical means of mass-sampling in complex terrain. The field precision was 0.02C, and unit sensor cost was about 15 cents. Watershed thermal climates were correlated with potential direct solar radiation and plant response trends. The season of water use, or elapsed time between leafing-out and leaf coloration, varied systematically with slope zones in the watershed. Climatological data obtained from the most convenient sampling point on the watershed were inadequate as a basis for climatological water balance estimates. Estimates were improved when chemically derived mean basin temperatures were used in conjunction with detailed soils information and plant response data. (Sink-Penn State Univ) W69-08378

ESTIMATING FORCED EVAPORATION FROM

COOLING PONDS, Geological Survey, Denver, Colo. For primary bibliographic entry see Field 05C. W69-08414

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,

Vanderbilt Univ., Nashville, Tenn.; Office of the Surgeon General (Army) (South Vietnam); and Johns Hopkins Univ., Baltimore, Md. For primary bibliographic entry see Field 01A. W69-08417

A PRACTICAL FIELD TECHNIQUE FOR MEA-SURING RESERVOIR EVAPORATION UTILIZ-ING MASS - TRANSFER THEORY, Geological Survey, Washington, D. C.

G. Earl Harbeck, Jr. Geological Survey Professional Paper 272-E, p 100-105, United States Government Printing Office, Washington, 1962. 6 p, 3 fig, 5 ref.

Descriptors: *Evaporation, *Energy budget, *Mass transfer, Wind velocity, Vapor pressure, Viscosity, Meteorological data, Seepage. Identifiers: Lake Hefner study, Lake Mead study, Evaporation-seepage method

Studies of evaporation made in recent years have provided values of the mass-transfer coefficient, N, in the equation E= Nu2 (eo - ea) for reservoirs having surface areas ranging from 1 to nearly 30,000 acres. The apparent correlation of N with reservoir surface area may in large part be associated with variations in the shape of the wind profile near the

surface resulting from differences in surface roughness. It appears that evaporation from many reservoirs can be determined with acceptable accuracy with a fairly simple system of instrumentation, processing, and analysis. (Sherman-Vanderbilt) W69-08418

SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION FROM WARM SEASON PERENNIAL FORAGE SPECIES,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

Basil D. Doss, O. L. Bennett, D. A. Ashley, and H. A. Weaver.

Agronomy Journal, Vol 54, p 239-242, 1962. 4 p, 2 fig, 5 tables, 9 ref.

Descriptors: *Soil moisture, Irrigation, Evapotranspiration.

Identifiers: Greenville fine sandy loam, Moisture extractions

Average yields of warm seasonal perennial forage species increased as soil moisture increased for all species except sericea which yielded highest at the intermediate moisture regime. Total water used depended more upon the amount of available water in the soil than on plant species. Moisture was first extracted at a shallow depth beneath the plant, and then at successively lower depths. (Bennett-USDA Agricultural Research Service)

EFFECTS OF SOIL MOISTURE REGIME ON YIELD AND EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE SPE-CIES.

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

O. L. Bennett, and B. D. Doss. Agronomy Journal, Vol 55, p 275-278, 1963. 4 p, 3 fig, 4 tables, 9 ref.

Descriptors: *Soil moisture, Evapotranspiration, Irrigation.

Identifiers: *Moisture variables, *Greenville fine sandy loam, Moisture extraction.

All species showed an increase in yield up to the intermediate moisture regime. Water was used by all species in proportion to the amounts available for evapotranspiration. Soil moisture was first extracted near the surface and at successively lower depths as soil moisture tension increased near the surface. (Bennett-USDA Agricultural Research W69-08427

EVAPOTRANSPIRATION BY IRRIGATED CORN,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

B. D. Doss, O. L. Bennett, and D. A. Ashley. Agronomy Journal, Vol 54, p 497-498, 1962. 2 p, 3 fig, 1 table, 7 ref.

Descriptors: *Evapotranspiration, *Soil moisture, Pan evaporation.

Identifiers: Moisture extraction patterns, Greenville fine sandy loam.

Evapotranspiration by irrigated corn in Alabama increased with plant development to a maximum of 0.30 inch per day at dough stage and afterwards decreased with physiological activity of the plant. The ratio of evapotranspiration by corn to open pan evaporation by corn to open pan evaporation varied from 0.38 at emergence to 1.12 during early dough stage, then declined to 0.95 at grain maturity. (Bennett-USDA Agricultural Research Service)

Group 2D—Evaporation and Transpiration

W69-08428

EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Auburn.

O. L. Bennett, B. D. Doss, D. A. Ashley, V. J.

Kilmer, and E. C. Richardson.

Agronomy Journal, Vol 56, pp 195-198, 1964. 4 p, 3 fig, 5 tables, 5 ref.

Descriptors: *Soil moisture, *Water use, Evapotranspiration, Irrigation.
Identifiers: *Nutrient uptake, Greenville fine sandy

Yields of Sudangrass, Starr millet, and Sart Sorghum and evapotranspiration rates increased as available soil moisture level increased. Sart Sorghum produced highest yield at all three moisture regimes. In general, nitrogen and potassium concentrations in plant tissue decreased with increasing soil moisture, but total uptake was usually higher with irrigation. (Bennett-USDA Agricultural Research Service) W69-08429

EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and and Water Conservation Research Alabama Agricultural Experiment Station, Au-

B. D. Doss, D. A. Ashley, and O. L. Bennett. Soil Science, Vol 98, No 3, pp 156-161, Sept, 1964. 6 p, 4 fig, 1 table, 10 ref.

Descriptors: *Irrigation, Moisture use, Moisture

Identifiers: Climatic conditions, Greenville fine sandy loam.

The effect of soil moisture regime and stage of plant growth on the rate of water used by cotton was determined on a Greenville fine sandy loam at Thorsby, Alabama, during the 1958 and 1959 growing seasons. Three soil moisture regimes were established: (a) no irrigation, (b) irrigated when 80 per cent and (c) 30 per cent of the available soil moisture had been removed from the surface 24 inches of soil. Soil fertility was maintained at a high level at all soil moisture regimes. The rate of moisture used was dependent on available soil moisture and stage of plant growth. Rate of moisture use increased as the amount of available soil moisture increased. The average rate was generally low in the spring while the plants were small, gradually increased until a maximum rate was reached during the period of blooming and boll development, and then gradually decreased until bolls opened. Maximum moisture-use rates ranged as high as 0.35 inch per day with average daily rates ranging from 0.11 to 0.24 inch, depending upon period of growth and soil moisture regime. (Bennett-USDA Agricultural Research Service)

MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Auburn

B. D. Doss, O. L. Bennett, and D. A. Ashley ARS Bulletin 41-112, Aug, 1965. 16 p, 7 fig, 5 tables, 16 ref.

Descriptors: *Moisture use, Evapotranspiration, Climate, Pan evaporation, Air temperature, Rain-

Identifiers: *Net radiation, Radiant energy, Greenville fine sandy loam.

Moisture use rates by 15 plant species were determined on a Greenville fine sandy loam soil at Thorsby, Alabama, during 1956 to 1962. Average daily moisture-use rates (ET) ranged from 0.03 to 0.24 inch, depending on season of year, available soil moisture, stage of plant growth, and species. In general, moisture-use rates were highest for cultivated crops and lowest for cool season perennial grasses. Moisture-use rates of species with similar seasonal growth characteristics differed little within a group, i.e., cultivated crops, warm season perennial, forages, cool season perennial legumes, and cool season perennial grasses. Moisture-use rates for 10-day periods determined from gravimetric soil sampling at 3- to 5-day intervals throughout the growing season for each species at each soil moisture regime were correlated separately with open pan evaporation and the inches of moisture equivalent of net radiation, assuming a constant value for heat of evaporization. These relations indicate that either open pan evaporation or net radiation may be used to estimate moisture use under conditions where moisture is not limiting, provided a relation has been established for the given species. To estimate moisture use on a daily basis, the appropriate ET/E or ET/Rn ratio is multiplied by the measured daily pan evaporation or inches moisture equivalent of net radiation. (Bennett-USDA Agricultural Research Service) W69-08431

MOISTURE USE BY FORAGE SPECIES AS RE-LATED TO PAN EVAPORATION AND NET RADIATION.

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 021. W69-08432

EVAPOTRANSPIRATION AT A WYOMING

MOUNTAIN BOG, Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. David L. Sturges.

J Soil and Water Conserv, 1968, 23 (1): 23-25, Il-

*Evapotranspiration, Descriptors: *Evaporation pans, Phreatophytes, Consumptive use, Fen, Wyoming. Identifiers: Potential evapotranspiration.

Computed potential evapotranspiration and pan evaporation were compared during three, 5-day intervals spaced through the growing season at a mountain bog in Wyoming's Medicine Bow Mountains. Pan evaporation was also compared with actual bog evapotranspiration on 6 days during a single growing season. Evaporation from a 6-foot diameter sunken pan averaged 0.144 inch per day. Potential evapotranspiration was calculated from a graphical solution of Penman's equation and averaged 0.100 inch per day. A prediction equation for computing potential evapotranspiration from daily pan evaporation was developed. Actual bog evapotranspiration was measured in bottomless caissons either 39 or 72 inches in diameter operated with the water table at the peat surface. Pan evaporation averaged 0.104 inch on the 6 days while bog evapotranspiration was 27 percent greater or 0.132 inch. W69-08458

MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE PON-DEROSA PINE STANDS, Forest Service (USDA), Albuquerque, N. Mex.

Rocky Mountain Forest and RangeExperiment Sta-

For primary bibliographic entry see Field 02G. W69-08461

SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN COLORADO, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 021. W69-08468

WATERSHED TREATMENT EFFECTS ON EVAPOTRANSPIRATION,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. B. C. Goodell.

In Sopper, Wm. E., and Lull, H. W. (ed). Int Symp Forest Hydrol Proc 1967: 477-482.

Descriptors: *Watershed management, *Evapotranspiration, *Forest management, Interception, Transpiration, Evaporation, Canopy, *Water yield improvement, Water utilization, Hydrologic cycle, Snow management, Energy

Watershed evapotranspiration depends on the spatial and temporal confluence of water and thermal energy at watershed surfaces. Four categories of surfaces may exist: (1) external surfaces of leaves and plant stems, (2) internal plant surfaces, (3) soil surface, (4) snowpack surface. Water becomes present on these surfaces through interception of precipitation, absorption and transport of soil water by plants, capillary flow of soil water, and by snow accumulation. Generally, radiant energy is the main source of the heat of vaporization. For any mass of vegetation per unit of land area, evapotranspiration should be maximum when plant substance is most uniformly distributed throughout the growing space. Interception of precipitation and radiation, and transport of soil water to transpiring surfaces are then maximum. Forest manipulation, such as partial clearing, causing heterogeneity in canopy and root distribution should minimize evapotranspiration. To be effective, persistent discontinuities must be produced in the canopy and/or root network. Substitution of vegetation of shallower root and/or canopy depth, longer dormant season, or lower transpiration ratio are other means by which watershed management can reduce evapotranspiration. W69-08481

SURFACE RESISTANCE OF CROP CANOPIES,

Rothamsted Experimental Station, Harpenden

(England). G. Szeicz, and I. F. Long. Water Resources Res, Vol 5, No 3, p 622-633, June 1969. 12 p, 7 fig, 3 tab, 28 ref.

Descriptors: *Evapotranspiration, *Transpiration, Mathematical models, Diffusion, Dispersion, Turbulence, Air circulation, Energy budget, Respiration, Stomata, Photosynthesis, Moisture tension, Temperature.

Identifiers: Stomatal resistance.

Three analytic and 2 empiric methods are described to calculate the surface resistance of crops transpiring at a measured rate. The profile method is applicable when detailed temperature, humidity, and wind profiles are measured; for the residual method, measurements of surface temperature, wind, and humidity are enough; for the heat balance method, the calculation is based on the ratio of potential to actual evaporation. For rough estimates, an empiric equation of Monteith or a relation between leaf area and surface resistance can be used. In southern England and in California all 3 analytic methods agree closely. Hourly values of surface resistance in California demonstrate the effect of water stress on an irrigated grass canopy by midday, whereas in England the surface resistance of a barley crop is constant for almost the whole day. From Aslyng's measurements of evaporation, the relation of surface resistance to soil-water potential is calculated to show how relative rates of transpiration and photosynthesis may change in response to water stress. For an equatorial rain forest in Kenya, mean

Streamflow and Runoff—Group 2E

monthly surface resistance varied systematically with soil moisture deficit, ranging between 0.3 and 1.1 sec per cm. (Knapp-USGS) W69-08573

2E. Streamflow and Runoff

THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON NETS OF VARIOUS ORDERS,

Illinois Univ., Urbana; and Illinois Univ., Cham-

For primary bibliographic entry see Field 07A. W69-08211

MISSISSIPPI WATER RESOURCE CON-FERENCE - 1969.
Mississippi State Univ., State College. Water

Resources Research Inst.

Priest, Melville S., Chairman. Proc Miss State Univ Water Resources Res Inst Conf, Apr 8-9, 1969. 169

Descriptors: *Water resources development, Pescriptors: "Water resources development, "River basin development, "Mississippi River, "Mississippi, Sedimentology, Sedimentation, Pesticides, Dams, River training, Forestry, Eutrophication, Eonomics, Navigation, Floods, Conferences. Identifiers: Conference Proceedings.

Recent water resources studies in Mississippi were discussed in a conference held in Jackson, Apr. 8-9, 1969. The subjects of the papers included in the proceedings include port development, shipping containerization, corrosion control, industrial development, forestry, eutrophication, pesticides, sediment sampling, sedimentation, river basin planning, floods, economics of water resource development, Mississippi River patamology, and small dam design. (See also W69-08222 and W69-08223). (Knapp-USGS)

FLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPER, WYOMING-VOLUME 1. Corps of Engineers, Omaha, Nebr.

For primary bibliographic entry see Field 04A. W69-08224

SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS, Institute of Hydrotechnical Research, Bucharest

(Rumania).

R. Amaftiesei, and F. Ionescu.

Symp on Use of Analog and Digital Computers on Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 189-197, 1968. 9 p, 7 fig, 3 ref.

Descriptors: *Mathematical models, *Computer models, *Flood routing, *Digital computers, Hydrographs, Stage-discharge relations, River forecasting, Flood forecasting, Streamflow forecasting, Water management (Applied). Identifiers: Romania, Rating curves.

Some applications of digital computers in solving flood routing and flood forecasting problems are presented. To reproduce the phenomenon of a flood wave propagation in an open channel, a mathematical model based on a finite difference scheme for numerical integration of Saint Venant's equations is used; in this model boundary conditions such as those given by tributaries, lateral discharges or local head losses, can easily be introduced. A mathematical model was used in the case of the Danube and Prut Rivers with embanked channels. The possibilities and conditions to simplify the equations are discussed. The use of the mathematical model for a short time forecast of a flood wave propagation on the lower stretch of Danube is outlined. Difficulties arise in the case of

untrained river channels with wide flood plains; attempts to solve them are discussed. (Knapp-USGS) W69-08232

HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM,

Corps of Engineers, Sacramento, Calif. Hydrologic

Engineering Center. For primary bibliographic entry see Field 07C. W69-08239

APPLICATION OF COMPUTERIZED OPERA-TIONS RESEARCH TECHNIQUE FOR OP-TIMUM ECONOMIC SIZING OF THE MIDDLE

FORK EEL RIVER PROJECT, California State Dept. of Water Resources. Ad-

vanced Techniques Section.

For primary bibliographic entry see Field 06A. W69-08240

SOME PROBLEMS OF **STREAMFLOW** FORECASTS BASED ON INFORMATION THEORY

Research Inst. for Water Resources Development,

Budapest (Hungary). K. Body, G. Erdos, and K. Szesztay

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 280-288, 1968. 9 p, 7

Descriptors: *Streamflow forecasting, *Routing, *Discharge (Water), Stage-discharge relations, Computer programs, Digital computers, Streamflow, Stream gages, Statistical methods.

Identifiers: River travel times, Information theory.

Regularities of the streamflow regime of a river system may be described by relations between the discharges of selected gaging stations. On the basis of data of 17 stations for about 2000 days, analyzed by digital computer systems, stage-discharge relations were determined to forecast discharges of the Danube River at the Iron-Gate section for 5 and 10 day periods. Travel times may be determined even under conditions of backwater effect. Utilizing the new possibilities offered by the computers, special forecast equations have been established for each day on the basis of the data most characteristic of the streamflow regime conditions of the given day. (Knapp-USGS) W69-08241

OPERATIONAL STREAMFLOW FORECAST-ING WITH THE SSARR MODEL,
Weather Bureau, Portland, Oreg. River Forecast

Center.

Vali P. Schermerhorn, and Donald W. Kuehl. Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 317-328, 1968. 12 p,

Descriptors: *Streamflow forecasting, *Computer models, *Computer programs, *Mathematical models, Rainfall-runoff relationships, Snowpacks, Snowmelt, Precipitation (Atmospheric), Synthetic hydrology, Hydrograph analysis, Flood forecasting, Routing, Systems analysis. Identifiers: River basin simulation, SSARR model.

The Streamflow Synthesis and Reservoir Regulation (SSARR) Model and the associated computer program and its application to headwater basin ru-noff simulation are described. The complete model was developed to synthesize the response of a com-plex river system to the input of precipitation and temperature plus the regulation by man-made structures. An alternate multi-zone mode of basin runoff computation provides snow accounting by subareas of the basin. An approach to adjustment of internal computation to observed conditions is presented. (Knapp-USGS)
W69-08245

APPLICATION OF STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION--'SSARR'--PROGRAM TO THE LOWER MEKONG RIVER, Corps of Engineers, Portland, Oreg. North Pacific

David M. Rockwood.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 329-344, 1968. 16 p.

Descriptors: *Streamflow forecasting, *Computer models, *Computer programs, *Mathematical models, Rainfall-runoff relationships, Routing, Synthetic hydrology, River forecasting, Hydro-graph analysis, Flood forecasting, Systems analysis, Reservoir operations, Regulation. Identifiers: Mekong River.

The application of the Streamflow Synthesis and Reservoir Regulation (SSARR) model to the Mekong River is described. Computed and observed hydrographs were compared and show that the model can provide accurate forecasts, even in basism with as few rain and stream gages as the Mekong. (Knapp-USGS) W69-08246

FLOOD PLAIN INFORMATION OF NORTH FORK OBION RIVER, HOOSIER AND GROVE CREEKS, UNION CITY, TENNESSEE.
Corps of Engineers Memphis, Tenn.

For primary bibliographic entry see Field 04A. W69-08247

LAG TIME OF NATURAL CATCHMENTS,

New South Wales Univ., Kensington (Australia). School of Civil Engineering. Arthur J. Askew.

New South Wales Univ Water Res Lab Rep No 107, July 1968, 209 p, 42 fig, 10 tab, 52 ref, 5 ap-

Descriptors: *Rainfall-runoff relationships, *Routreactions. "Rainfall-funoit relationships, "Routing, *Runoff forecasting, *Mathematical models, *Computer programs, Hydrographs, Hyetographs, Hydrograph analysis, Synthetic hydrology. Identifiers: Lag computation (Runoff).

An investigation was made of the values of lag time for natural catchment areas, as measured from center of mass of excess-rainfall to center of mass of resulting runoff. Any variation in this value for an individual catchment is an indication of a nonlinear response. Values of lag were measured for a range of floods on 5 catchment areas. The difference in value between catchments was found to be a function of the catchments' characteristics, while variation in the values for an individual catchment was strongly related to the magnitude of the floods. As the degree of this variation was fairly constant for the areas studied, the degree of nonlinearity was also considered to differ little between the catchments. The development of 3 general formulae required a detailed analysis to be made of a large volume of hydrologic data by an objective systematic procedure. For this purpose lag was measured to the center of mass of direct runoff and a weighted mean discharge measure of flood magnitude was devised. Numerous hyetograph characteristics were measured and studied, but none appeared to have any significant influence on the value of lag time. Computer program listings for computing lag-discharge relationships and for regression analysis of lag-discharge relationships are included. (Knapp-USGS)

AN OUTLINE OF POLAND'S HYDROGRAPHY (POLISH),

Warsaw Univ. (Poland). Faculty of Biology; Warsaw Univ. (Poland). Faculty of Geography; and Warsaw Univ. (Poland). Faculty of Geophysics. For primary bibliographic entry see Field 02A. W69-08253

Group 2E—Streamflow and Runoff

DROUGHTS IN FINNISH WATERCOURSES WITH REFERENCE TO WATER SUPPLY AND POLLUTION CONTROL (FINNISH),

Finnish Hydrological Office, Helsinki.

Eero Kajosaari.

Helsinki, Painovalmiste, 1968. 118 p, 24 fig, 12 tab. 91 ref.

Descriptors: *Drought, *Streamflow forecasting, Streamflow, River regulation, Water storage, Lakes, Statistical methods, Duration curves, Hydrographs, Frequency analysis, Water management (Applied). Identifiers: *Finland.

Droughts and water-supply problems in Finland are discussed from the point of view of water supply and hydroelectric power management. A drought is defined as a period longer than 6 months with a mean runoff less than the mean runoff of the entire period of record of the watercourse. The 17 analyzed watercourses are unregulated. Dry periods of 5, 15, 31, 61, 91, 121, and 151 days were analyzed by digital computer. To describe numerically the characteristics of dry periods, the concept of specific deficit was used. It is the hypothetical storage volume per unit of catchment area required to maintain runoff equal to the long-term mean runoff during periods of droughts. Increasing catchment size and increasing lake influence diminish the difference between long-term and short-term drought runoff, but have no effect on relative drought severity. The results of frequency analysis are used to estimate long-term safe yield. (Knapp-USGS) W69-08254

GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA,

Geological Survey, Jackson, Miss. For primary bibliographic entry see Field 02F. W69-08264

EFFECT OF HEAVY LATE-FALL PRECIPITA-TION ON RUNOFF FROM A CHAPARRAL WATERSHED,

Rocky Mountain Forest and Range Experiment Station.

Paul A. Ingebo.

USDA Forest Service, Research Note RM-132. 2 p, 1969, 2 fig.

Descriptors: *Rainfall-runoff relationships, *Water storage, *Arizona, Arid lands, Chaparral, Demonstration watersheds, Water balance, Storm runoff, Rainfall, Streamflow, Time log, Hydrologic budget, Flow characteristics, Hydrologic equation, Regulated flow, Water yield, Recharge, Overburden.

Nov/Dec precipitation in 1965 at Three Bar experimental watershed, Arizona, measured 24.29 in., about 7 times the preceeding 9-yr. average. Streamflow during this period was 2.4 area-inches. A water balance equation indicated a 19.9 in. increase in stored water. Streamflow responded little to the 8 in. of rainfall in Nov., presumably because of soil-water deficits. But, with additional precipitation in early Dec. streamflow responded markedly, even though storage also increased. The uniform rate of streamflow (during most of Dec.) compared to the more sporadic rainfall suggests a continuing buffering action in movement of water through the watershed. A recession-type flow continued until mid-Jan. and is thought to have extended through the period of light spring rains. Rational solution of the water balance equation necessitates recognition of the storage potential within the watershed. This storage potential is a peculiarity of the regolith; thus, the depth and characteristics of the overburden appear to be important considerations in studying water yields, storage, and flow behavior of watersheds. (Sherbrooke-Ariz) W69-08285

STREAMFLOW - AN IMPORTANT FACTOR IN FOREST MANAGEMENT IN THE COASTAL

PLAIN, Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. Cortland E. Young, Jr.

South Lumberman 215 (2680):109-110, Dec 1967. 2 p, 2 fig.

Descriptors: *Streamflow, *Forest management, *Storm runoff, *Design criteria, Drainage, Bridges, Atlantic Coastal Plain, Wetlands, Forests, Water resources, Low flow, Weirs.

This paper discusses the importance of streamflow to the forest manager in the lower coastal plain and presents an example of streamflow behavior from a forested watershed. Streamflow data are needed to aid in drainage system and bridge designs and water resource development. Streamflow records to date indicate that the amount of stormflow produced from a lower coastal plain watershed is highly dependent on the storage potential of the watershed prior to rainfall. On the average this watershed produces more stormflow than forested watersheds in the mountains and Piedmont; however, streamflow from our watershed is intermittent with no flow periods as long as 1 to 2 months occurring each year. W69-08439

AREAL EXTENT OF SNOW COVER IN RELA-TO STREAMFLOW IN CENTRAL COLORADO,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02C. W69-08454

STREAMFLOW VOLUMES AND HYDRO-GRAPHS BY FLUORESCENT DYES,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 07B.

FORECASTS WITH VARYING RELIABILITY,

Harvard Univ., Cambridge, Mass.

Myron B. Fiering. Proc, Amer Soc Civil Eng, Vol 95, No SA3, p 629-644, June 1969. 16 p, 2 tab.

Descriptors: *Streamflow forecasting, *Variability, *Mathematical models, *Optimization, *Design, Systems analysis, Water resources, Monte Carlo Method, Operations, Reliability, Computers.

An application of computing and systems analysis techniques to water resources design was made. The objective of the study was to combine the selection of components, the specification of optimal operating policies and the role of streamflow forecasting in a single mathematical entity. No formalism for forecasting was given, but based on a model for flow sequences, a technique was developed by which the analyst could discern whether or not it was useful to include forecasting in the operating policy. The procedure made use of statistical theory and the Monte Carlo Method. Subsequent work particularly that which involved mathematical programming offered new insights into the construction of optimal operating schemes. By means of regression analysis it was possible to construct operating rules which explicitly accommodated flow forecasts of different reliability. (Thiuri-Cornell) W69-08545

RANDOM WALK AND RANDOM ROUGHNESS

MODELS OF DRAINAGE NETWORKS, Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.

Ido Seginer. Water Resources Res, Vol 5, No 3, p 591-607, June 1969. 17 p, 11 fig, 2 tab, 18 ref.

Descriptors: *Drainage patterns (Geologic), *Topography, *Statistical models, Stochastic processes, Probability, Monte Carlo method, Streams, Drainage systems, Watersheds (Basins). Identifiers: Drainage geometry, Topographic roughness, Random walk method.

A random walk model of a drainage network is generated on an underlying matrix by selecting at random the drainage direction out of the elementary areas. In a random roughness model, roughness heights of the elementary areas rather than drainage directions are assigned at random. The resulting topography of that model then uniquely determines the drainage pattern. An equivalence of the 2 models is suggested by the similarities found in the mode of construction and by the equality of the probabilities of occurrence of some simple configurations. The random roughness model can yield values of primary probabilities, i.e., probabilities which can be used in the construction of a random walk model. The various types of drainage patterns are classified by the sets of primary probabilities which would generate them. Thus outcomes of homogeneous and isotropic matrices are classified as pure dendritic patterns. Outcomes of homogeneous matrices with probability sets derived from a ous matrices with probability sets derived from a sloping plane roughness model are classified as general dendritic (including parallel) patterns. Trellis, annular, and other patterns are considered as subgroups of the class of patterns generated on all other possible matrices. (Knapp-USGS) W69-08571

ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL FLOW,

California Univ., Davis. Dept. of Water Science and Engineering.

Theodor Strelkoff. ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap 6557, pp 861-876, May 1969. 16 p, 3 fig, 23 ref, append.

Descriptors: *Open channel flow, *Equations, *Mathematical models, Unsteady flow, Waves (Water), Reynolds number, Turbulence, Stress, Discharge (Water), Streamflow, Viscosity, Shear. Identifiers: St. Venant equations.

One-dimensional equations of continuity, momentum, and energy for unsteady, spatially varied flow in a fixed-bed open channel of arbitrary configuration are derived from the point forms of the corresponding hydrodynamic equations by integrating the latter over a deforming region of space com-prising a slice of differential thickness across the flow with a top always coincident with the fluctuating water surface. To bring the equations to the form of Saint Venant in fixed and accelerating reference frames, departures from hydrostatic pressure conditions in a cross section due to lateral acceleration, viscous deformation, and turbulent Reynolds stresses are reproduced exactly; the rate of energy dissipation in a cross section is uniquely related to wall shear over the wetted perimeter; the term accounting for lateral discharge depends upon its nature; bulk outflow is considered. (Knapp-USGS) W69-08589

PROPAGATION OF FLOOD WAVES IN OPEN CHANNELS,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

Bahram Mozyeny, and Charles S. Song. ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap 6561, pp 877-892, May 1969. 16 p, 15 fig, 13 ref, append.

Descriptors: *Flood routing, *Open channel flow, *Waves (Water), *Unsteady flow, Equations, Mathematical models, Digital computers, Floods, Flood forecasting, Model studies. Identifiers: Method of characteristics.

Using the method of characteristics, the equations of motion and continuity were numerically solved for the case of a sinusoidal flood wave in a long rectangular open channel. The effects of various parameters, such as the friction coefficient, slope, distance of propagation, initial amplitude of the flood wave, etc., on the damping of the flood wave were studies. It was revealed that the maximum dimensionless discharge and depth are exponential functions of the distance traveled. An empirical formula relating the damping coefficient and other flow parameters was drived. A light nonlinear rela-tionship between the initial flood amplitude and that at a downstream section was noted. (Knapp-USGS) W69-08590

SYSTEMATIC VARIATION PATTERN OF AN-

NUAL RIVER FLOWS,
Melbourne Univ., Parkville (Australia). Dept. of Engineering; and Scott and Furphy, Melbourne

CAUSTRAIIa).
Frank W. F. Waitt, and Ian C. O'Neill.
ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap
6531, p 787-809, May 1969. 23 p, 4 fig, 8 tab, 17 ref, append.

Descriptors: *Streamflow, *Statistical methods, *Correlation analysis, *Variability, Regression analysis, Streamflow forecasting, Hydrographs, Data collections, Probability, Water level fluctuations, Rainfall-runoff relationships. Identifiers: Streamflow variability.

Statistical analysis of annual river flows in the United States, some European countries and southern Australia, in latitudes higher than 34 deg. N or S indicates a useful significant relationship between the standard deviation of the logarithms of inches depth of annual runoff from a river catchment and the geometric mean annual runoff depth. For the separate zones, equations and tables are given for the evaluation of probabilities of annual flow of a river from its estimated geometric mean depth of annual runoff and these can be used where records are inadequate or as a check on other methods. The logarithmic distribution was found to be appropriate for statistical analysis, with a general trend towards slight negative skewness. Tests of a small sample suggest that dry season flows may follow a similar pattern to that of the annual flows. (Knapp-USGS) W69-08591

DISPERSION OF SILT PARTICLES IN OPEN

CHANNEL FLOW, Iowa Univ., Iowa City. Inst. of Hydraulic Research. For primary bibliographic entry see Field 02J. W69-08592

FLOOD PLAIN INFORMATION NEUSE AND TRENT RIVERS AND JACK SMITH CREEK, NEW BERN, NORTH CAROLINA. Corps of Engineers, Wilmington, N. C.

For primary bibliographic entry see Field 04A. W69-08593

WATER RESOURCES AND DEVELOPMENT: WATER RESOURCES.

Geological Survey, Portland, Oreg.

K. N. Phillips Mineral and Water Resources of Oregon, Dept of Interior Rep for Comm on Interior and Insular Affairs, p 325-369, 1969. 45 p, 13 fig, 13 tab, 55 ref.

Descriptors: *Water resources, *Oregon, *Surface waters, *Groundwater, Streamflow, Aquifers, Water supply, Water utilization, Water quality, Water yield, Water management (Applied), Hydrologic data, Data collections.

Oregon has a large supply of water, but it is unevenly distributed with respect to both area and time. Floods and shortages of water are frequent. The climate of the western third of Oregon is characterized by moderate temperatures, wet winters, and dry summers; about 78% of the annual precipitation occurs in the period October to

March. The eastern 2/3 of the State has greater extremes of temperature but less seasonal variation in precipitation; about 65% of the precipitation occurs in the period October to March. The average annual precipitation ranges from about 200 in. at places in the Coast and Cascade Ranges to less than 10 in parts of north-central and southeast Oregon. The statewide average is about 27 in. per yr. Flooding and drought are due to natural causes and have been alleviated in some areas by storage, drainage, diking, and irrigation. In some places groundwater is too highly mineralized for most uses. Repeated use of water for irrigation tends to increase the concentration of dissolved minerals. Nutrients stimulate undesirable algal growths in rivers and lakes. Municipal and industrial wastes at times deplete the natural supply of dissolved oxygen in streams and thus block the passage of migrant anadromous fish. One of the most difficult problems is to balance the divergent interest of those who recognize the growing needs for use and control of the State's water supplies. Streamflow and groundwater availability in Oregon's rivers and groundwater basins are summarized and the data are tabulated. (USGS) W69-08604

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 6. MISSOURI RIVER

Geological Survey, Washington, D. C. For primary bibliographic entry see Field 07C. W69-08605

FLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE MAY COUNTY, NEW JERSEY. Corps of Engineers, Philadelphia, Pa.

For primary bibliographic entry see Field 04A. W69-08609

FLOOD PLAIN INFORMATION, UPHAM BROOK, HENRICO, VIRGINIA. Corps of Engineers, Norfolk, Va.

For primary bibliographic entry see Field 04A. W69-08610

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAM-

FLOW REGULATION, State Hydrological Inst., Leningrad (USSR). For primary bibliographic entry see Field 07C. W69-08612

USE OF DIGITAL COMPUTERS FOR MATHE-MATICAL MODELLING OF HYDROLOGICAL PROCESSES,

Politekhnicheskii Institut, Tiflis Gruzinskii For primary bibliographic entry see Field 07C. W69-08624

THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF REGULA-

TION, N. A. Kartvelishvili.

Transl from Gidrometeorologicheskoe Izdatel'stvo, Leningrad, 1967. 223 p, 79 fig, 4 tab, 97 ref, 7 ap-pend. Available from Clearinghouse as TT-68-50478 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Statistical methods, *Stochastic processes, *Streamflow forecasting, *River regulation, Markov processes, Synthetic hydrology, Ru-*Stochastic noff forecasting, River forecasting, Reservoir operation, Water management (Applied). Identifiers: USSR.

The annual volumes of river runoff constitute a sequency of random variables. In studies of runoff regulation, there is a tendency to replace the theory of random events with the theory of stochastic processes, using the analysis of alternation of ru-

noff volumes during high and low water phases and correlating runoff between contiguous time intervals. The literature of stochastic hydrology is surveyed, summarized, and presented systematically in a form intended to aid in further research and development of the techniques of using stochastic methods in river management, but not as a textbook or manual for computations. The principal aim is to help develop methods for reducing stochastic problems to algorithmic form for computer processing, and to apply the stochastic method to regulation. No advanced or specialized mathematical background is necessary for comprehension of the book, but a good general knowledge is required. A bibliography of the basic work in the field is included. (Knapp-USGS) W69-08626

2F. Groundwater

CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES,

California State Dept. of Water Resources. For primary bibliographic entry see Field 04B. W69-08235

PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION

General Electric Co., Santa Barbara, Calif. TEM-

For primary bibliographic entry see Field 07C. W69-08236

GROUND WATER RESOURCES IN THE SOUTHWEST **JAPAN** PLAIN, **KOCHI** (JAPANESE),

Industrial Science and Technology Agency, Kawasaki (Japan). Geological Survey. S. Takahashi, and S. Nagai.

Bull Geol Surv of Japan, Vol 19, No 10, pp 13-29, Oct 1968. 17 p, 19 fig, 2 tab, 5 ref.

Descriptors: *Aquifers, *Water resources, *River basins, Water supply, Artesian wells, Water table, Subsidence, Earthquakes, Salinity, Chlorides, Streamflow, Water resources development. Identifiers: *Japan, Kochi Plain (Southwest Japan).

Groundwater resources of the Kagami, Kokubu, and Monobe river basins of southwest Japan were studied with regard to geohydrological conditions. Withdrawals total about 51,100 cubic meter per day, of which 21,900 cu m is artesian water and 29,200 is from water table aquifers. Recharge of the artesian aquifers in the Kokubu River estuary area is from streamflow of Kokubu and Kagami Rivers. It is of interest that this area is characterized by land subsidence cause by a strong earthquake in 1946 and since that time contamination of the groundwater has increased, reaching 5000-15,000 ppm of chlorine. In general, the Monobe River basin can be considered as having good possibility for the further development of groundwater resources in the Kochi plain. (Gabriel-USGS) W69-08248

GEOHYDROLOGIC SUMMARY PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA,

Geological Survey, Jackson, Miss.

L. W. Lang. Geol Surv Open-file Rep, 1967. 44 p, 10 fig, 2 plate, 4 tab, 41 ref.

Descriptors: *Water resources, *Geohydrologic units, *Streamflow, *Surface-groundwater rela-tionships, *Mississippi, Aquifers, Appraisals, En-vironment effects, Rainfall disposition, Water quality, Water users, Saline water, Estuaries, Low flow, Storage capacity, River basins. Identifiers: *Pearl River basins, Potential water

sources, Low flow yields.

Group 2F—Groundwater

The environmental framework of the 8,760 sq mi Pearl River basin, Mississippi and Louisiana, is described and appraised as to the quantity and quality of available water by basin segments both in aquifer units and a streamflow. The report discusses present use of the aquifers and surface waters, relationship of groundwater to streamflow, aquifer and well characteristics, and potential sources of supply including saline water as a resource. An annotated bibliography of 41 selected reports is included. Fresh groundwater occurs from the surface to depths ranging from sea level in the upper basin segment to more than 3,000 ft. below sea level in the lower segments; a total of 3 billion ac ft of water is in aquifer storage. Of the average annual rainfall on the river basin (26 million acre ft), about 9 mil ac ft is recoverable from aquifers and streamflow for water supply. Low flow yields vary from 0.20 cu ft/sec per square mile of drainage area in a reach of the basin underlain by permeable sandy deposits to 0.05 cfs per sq mi of drainage area where the basin is formed in clay, marl, and finer sands. Wells with pumping rates of 500 to 1,000 gpm are common basinwide, and some deep wells in the central lowlands flow at rates up to 3,500 gpm. Nearly all the groundwater in the 6 or more major aquifer systems is of good to excellent quality, and streamflow is even less mineralized (median dissloved solids 50 ppm or less at 10 sites in the basin). The basin estuary is a potential source of freshwater (less than 1,000 ppm dissolved solids) to moderately saline water (3,000 to 10,000 ppm) that will require special planning and management for many uses. (Lang-USGS) W69-08264

SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS IN KANSAS, Geological Survey, Lawrence, Kans.; and Kansas State Geological Survey, Lawrence.

Kans State Geol Surv Map No M-5, 1967. 1 sheet. Bayne, Charles K.; Ward, John R., Compilers.

Descriptors: *Groundwater, *Aquifers, *Kansas, *Cenozoic era, Specific yield, Zone of saturation, Water yield, Water wells. Identifiers: Cenozoic aquifers (Kansas)

The saturated thicknesses and specific yields of Cenozoic deposits in Kansas are shown on a map scaled 1:500,000. (Knapp-USGS)

TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH ACID KAOLINITIC SOIL,

Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

J. C. Corgey, and J. W. Fenimore. Intern'l Journ. Appl. Radiation and Isotopes, Vol 19, No 10, pp 741-746, 1968. 5 p, 4 fig, 13 ref.

Descriptors: *Groundwater movement, *Radioactive tracers, *Acidic soils, Aquifers, Retention, Kaolinite, Heavy water, Chlorides, Ions, Soil water movement, Arid climates, Wet climates.

Recent investigations with chloride ions in soils from arid regions concluded that chlorides are equal or preferable to tritium as groundwater tracers. These soils are normally neutral to basic, and do not retain anions. The present study utilized acid kaolinitic clays, from regions of abundant rainfall. It demonstrates that the breakthrough for chloride was retarded more than that for tritium, indicating interaction of chloride ions with acid soils. Thus chloride and other negatively charged ions, which may be preferable in many arid regions, have limited usefulness as water tracers in acid soils. (Sherbrooke-Ariz) W69-08286

GEOLOGY AND GROUNDWATER OCCUR-RENCE IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO, Geological Survey, Washington, D. C.

James B. Cooper, and Edward C. John.

New Mexico State Engineer, Tech Rept No 35, 1968. 108 p, 7 fig, 2 pl, 5 tab, 58 ref.

*New Mexico, Semiarid climate, Uranium Radioisotope, Radioactivity, Aquifer characteristics, Artesian well, Deep wells, Depth, Geologic formations, Groundwater mining, Groundwater recharge, Hydrogeology, Transmissivity, Underground storage, Water table, Water chemistry, Shallow wells. Identifiers: McKinley Co., New Mexico.

This semiarid area of about 1,300 sq. mi. is topographically diverse, without perennial streams or large permanent bodies of surface water. Groundcommonly under artesian pressure, is water, commonly under artesian pressure, is yielded to wells from at least 16 distinct aquifers. Yields of 300 g.p.m. or more are obtained from wells that tap the aquifer in the Glorieta Sandstone and San Andres Limestone. The other aquifers commonly yield only 5 to 30 g.p.m. Well depth ranges from 20 ft. to more than 1,200 ft., while water levels range from above surface to about 800 ft. below. Water quality varies widely, but most groundwater is chemically suitable for stock and domestic use. Most aquifers receive only scant recharge directly from precipitation because their outcrop areas are small. In most of the area withdrawals are minimized by the dominance of ranching. Since 1951 mining of uranium ore and related groundwater withdrawal in the Ambrosia Lake and Smith Lake areas has created widespread interest in the occurrence, control, and disposal of groundwater. Water associated with uranium deposits is slightly radioactive. The availability, quantity and quality of groundwater are related to the geologic regimen. (Sherbrooke-Ariz) W69-08287

GROUNDWATER RESOURCES OF UPTON

GOUNTY, TEXAS, Geological Survey, Washington, D. C. D. E. White. Texas Water Develop Bd, Rept 78, May, 1968. 132 p, 21 fig, 7 tab, 42 ref.

Descriptors: *Water resources, *Texas, Arid lands, Aquifer characteristics, Depth, Discharge, Geologic formations, Groundwater mining, Groundwater recharge, Hydrogeology, Hydrologic aspects, Observtion wells, Overdraft, Transmissivity, Underground forage, groundwater movement, Water table, Water sources, Water supply, Topography, Drainage, Geohydrologic units, quifers, Water chemistry, Brine disposal, Sulfates, Fluorides, Dissolved solids solved solids.
Identifiers: *Upton Co.

Upton County, in western Texas, is semiarid in climate, with a high rate of evaporation and occasional years of rainfall as low as 6 inches or less annually. The county's groundwater resources are in-sufficient to furnish all the water needs of cities, in-dustries, irrigation and livestock; consequently, water is imported from adjoining counties. In-creased utilization of the Trinity Sand aquifer is resulting in an acceleration of the rate of waterlevel decline and a concomitant decrease in yields. New large-scale development should be located in new areas and wider spacing of wells and smaller yields should be considered. Chemical analysis shows that few of the Trinity Sand wells meet the standards of the U. S. Public Health Service, the sulfate, fluoride and dissolved-solids concentrations being too high. The present study yielded evidence that some of the wells have been contaminated, presumably from the disposal of oil-field brines into unlined surface pits. A network of 6 observation wells has been established. (Sherbreche Adio) brooke-Ariz) W69-08288

THE CONTROL OF GROUNDWATER OCCUR-RENCE BY LITHOFACIES IN THE GUADALU-PIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO, Massachusetts Univ., Amherst.

For primary bibliographic entry see Field 04B. W69-08294

GROUNDWATER POTENTIAL OF KARST

AQUIFERS IN SAUDI ARABIA, Ministry of Agriculture and Water, Riyadh (Saudi Arabia); and Food and Agriculture Organization of the United Nations, Rome (Italy). David J. Burdon, and Galip Otkun.

Internat'l Assoc Hydrogeol, Congress of Istanbul, 1967, Memoir 8, pp 165-176, 1968. 12 p, 2 fig, 1 tab, 14 ref.

Descriptors: *Karst, Water resources development, Descriptors: "Karst, Water resources development, Ions, Arid lands, Water chemistry, Aquifer characteristics, Carbonate rocks, Geologic formations, Sandstones, Sulfates, Water sources.

Identifiers: *Saudi Arabia.

The purpose of this paper is to draw attention to the groundwater potential of the karst aquifer in Saudi Arabia before the sandstone aquifers ap-proach full development. The discussion of general hydrogeological conditions includes details of carbonate and sulfate formations. Karst formation and preservation is considered in relation to (1) pore space and openings in carbonate rocks, (2) development of joints and fissures, (3) enlargement of openings, joints and fissures, (4) marine erosion of karst surfaces, and (5) infilling of karst openings. Data are presented on water chemistry. Many of the carbonate waters are acceptable for most purposes, while the sulfate waters (where free of chloride additions) would generally be acceptable for irrigation uses. On the basis of location, geological history, stage of present development and future development potential, these karst aquifers are divided into 3 groups for discussion. The karstified aquifers may in the long run prove as valuable water producers in Saudi Arabia as the sandstone aquifers. (Sherbrooke-Ariz) W69-08296

THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER EXPLORA-TION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,

Zagreb Univ. (Yugoslavia). Geophysical Inst. For primary bibliographic entry see Field 07B. W69-08297

GROUND WATER OF THE WESTERN DESERT

IN IRAQ, Baghdad Univ. (Iraq). Dept. of Geology For primary bibliographic entry see Field 03C.

WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., Geological Survey, Tucson, Ariz. Water Resources

E. S. Davidson.

Internat'l Assoc Hydrogeol, Congress of Istanbul, 1967, Memoir 8, pp 552-558, 1968. 7 p, 4 fig.

Descriptors: *Analog models, *Water table, *Arizona, Arid lands, Discharge (Water), Flow measurement, Groundwater movement, Riverflow, Aquifer characteristics, Natural recharge, Transmissivity, Underground storage, Water quality, Estimating, Water supply, Analog computers. Identifiers: *Tucson basin.

This paper describes a water-resources study of the Tucson basin in terms of hydrologic data available, new data collected, and analysis of the hydrologic system utilizing a groundwater analog model. The study was prompted by concern over declining groundwater levels, as much as 60 ft. since 1940. Water utilization was 55% irrigation, 35% domestic and public supplies, and 10% industrial supply. More than 1000 wells were studied to obtain data on aquifer transmissibility, tracing and evaluation of individual aquifers and correlation of aquifers with rock units. Streamflow records were available and were represented for expenses and correlation. and were programmed for a computer. All streams in the Tucson basin have a very large standard deviation of annual flow. Analog-computed water-levels for 1940 closely resembled actual data. With adjustment the analog-model balancing will effectively measure annual recharge. The discharge is known or can be projected, and the model will pro ject approximate water levels that may be expected in the future. Estimates indicate that groundwater stored in the Tucson basin is very large in relation to present annual pumpage. (Sherbrooke-Ariz) W69-08299

INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID BASIN ARIZONA,

Geological Survey, Tucson, Ariz. Water Resources

R. L. Laney. Internat'l Assoc Hydrogeol, Congress of Istanbul, 1967, Memoir 8, pp 559-565, 1968. 7 p, 3 figs, 1

Descriptors: *Geochemistry, *Arizona, Groundwater basins, Arid lands, Aquifer characteristics, Water chemistry, Solutes, Geohydrologic units, Underground streams, Ion exchange, Bicarbonates, Calcium, Calcium sulfate, Chlorides, Fluorides, Sodium sulfate, Sodium, Groundwater movements, Percolating water, Drainage effects, Hydrogeology. Identifiers: *Tucson basin.

Groundwater in the Tucson basin was divided into seven chemical types on the basis of relative amounts of calcium, sodium, bicarbonate, and sulfate and the absolute amount of chloride. The water types were related to geohydrologic environments. Groundwater was of suitable chemical quality for most industrial, domestic, and irrigation uses, but in places the dissolved-solids content and fluoride exceeded optimum concentrations. Water quality varies with depth, but the variation was not uniform throughout the basin. The chemical composition of groundwater was altered by deposits within 1 to 3 mi. of the recharge areas. Changes in the chemical composition of water during the transition from rainwater to groundwater depended on the relative similarity between dissolved compounds and the mineralogical composition of the soil. These changes were traced for the different regions of the basin and include a four step process in the northeast section. Ion exchange and reactions related to lithification and cementation of deposits may have modified the composition of groundwater. (Sherbrooke-Ariz) W69-08300

INDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,

California Univ., Los Angeles. Dept. of Engineer-

ing. Y. Y. Haimes, R. L. Perrine, and D. A. Wismer. Water Resources Center, Univ of Calif, Contrib, No 123, p 1-53, March 1968. 53 p, 4 tab, 9 fig, 34

Descriptors: *Optimization, *Aquifers, *Water management (Applied), *Boundaries (Surfaces), *Transmissivity, *Storage, Wells, Pressure, Estimating, Digital computer, Systems analysis, Flow. Identifiers: Decomposition, Multilevel optimization techniques.

Decomposition and multilevel optimization techniques were applied to the identification of transmissivity, storage and boundary configuration parameters characterizing flow of an aquifer. The goal was to find the simplest efficient methods of selecting optimal estimates for the aquifer parameters. The use of these values would, in turn, permit the best predictions to be made regarding aquifer response to any demand. A multiple well system was formulated for any integral number of produc-ing wells. Pressure observation and production data were utilized for optimal estimation of parameters. Two different techniques, the gradient method and the direct-search, were utilized for optimization of the first level. The Gauss-Spidel algorithm was utilized for the optimization of the second level. A four-well system was introduced for an example and its parameters determined using a digital computer. (Thiuri-Cornell) W69-08550

EFFECT OF SEDIMENT CONCENTRATION ON WELL RECHARGE IN A FINE SAND AQUIFER, Texas A and M Univ., College Station; and Florida Univ., Gainesville.

Md. Ataur Rahman, Ernest T. Smerdon, and Edward A. Hiler.

Water Resources Res, Vol 5, No 3, p 641-646, June 1969. 6 p, 7 fig, 2 tab, 6 ref.

Descriptors: *Recharge wells, *Sedimentation, Clays, Model studies, Hydraulic models, Filtration, Sands, Permeability, Porosity, Hydraulic conduc-Sands, Permentivity, Aquifers.
Well-filter

clogging, clogging, Aquifer testing.

A model recharge well was constructed to simulate recharge into wells in a fine sand aquifer. The sand in the model aquifer was uniform fine sand and had a uniformity coefficient of 1.25 and an effective diameter of 144 microns. Both clear tap water and sediment-laden water were used for recharge. Sediment-laden water was obtained by mixing 50% bentonite and 50% kaolinite with tap water. Sediment concentrations were 100, 200, and 500 ppm. The piezometric surfaces near the recharge well were measured during the tests. Migration of sediment into the aquifer was determined by sampling the aquifer sand after the tests at predetermined distances from the well. The sediment in the recharge water highly affected the rate of recharge. During the period of the tests a reduction in hydraulic conductivity of the model aquifer of 15-46% occurred as a result of recharge with sediment-laden water. Most of the sediment deposited in the aquifer was retained near the well screen. (Knapp-USGS) W69-08574

SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE FLOW PROBLEM,

Drexel Inst. of Tech., Philadelphia, Pa. R. L. Drake, F. J. Molz, Irwin Remson, and A. A Fungaroli.

Water Resources Res, Vol 5, No 3, pp 673-684, June 1969. 12 p, 3 fig, 1 tab, 12 ref.

Descriptors: *Mathematical models, *Mathematical studies, *Approximation method, *Groundwater movement, Flow, Porous media, Saturated flow, Unsaturated flow, Synthetic hydrology, Simulation analysis, Computer programs, Digital com-

Identifiers: *Similarity approximation, Radial groundwater flow.

A useful mathematical technique in the study of radial flow of underground water is the application of similarity transformations, such as Boltzmann's transformation. The transformations lead to approximations that are shown to be valid if certain physical parameters satisfy given limiting condi-tions. A nonlinear partial differential equation is formulated describing the radial flow of soil moisture. A similarity approximation is used to transform the partial differential equation into a nonlinear ordinary differential equation. Criteria by which to judge the applicability of the similarity approximation are derived. Several monotonicity properties of the transformed moisture as a function of the similarity variable are derived. The properties are used to develop numeric procedure for the solution of the transformed equation. The procedure is used to study the radial flow of soil moisture to a cylindric sink for diffusivities which vary linearly, quadratically, and exponentially with soil moisture. The solutions show that the moisture front steepens with increasing nonlinearity. (Knapp-USGS) W69-08575

TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS, lowa State Univ., Ames. Dept. of Agronomy. A. W. Warrick, and Don Kirkham.

Water Resources Res, Vol 5, No 3, pp 685-693, June 1969. 9 p, 4 fig, 8 ref. Grant No WP-00070-05

*Drainage systems, *Ditches, *Mathematical models, Synthetic Drainage engineering, Dewatering, Descriptors: *Seepage, hydrology, Hydraulic conductivity, Anisotropy, Soils, Soil water movement, Groundwater movement. Identifiers: Nomogram.

Seepage of ponded water to full, equally spaced ditch drains is analyzed mathematically, considering 4 distinct cases. In the first case, an impermeable soil barrier is present at a finite depth, and the ditches are a finite distance apart; in the second case, no impermeable soil barrier is present, and the ditches are a finite distance apart; in the third case, an impermeable barrier is present, but the ditches are in effect an infinite distance apart; and in the fourth case, no impermeable barrier is present, and the ditches are in effect an infinite distance apart. The ditches may penetrate part or all of the way to an impermeable barrier. Schwartz-Christoffel transformations are used to solve the first case. Solutions for the other 3 cases are found by taking limiting values of the first case. Flow nets illustrate the results. In one calculated example, the flow rate without an impermeable barrier is 10% greater than when an impermeable barrier exists at a depth of 0.2 times the ditch semispacing. The flow nets illustrate the rapid decrease in surface water intake at increasing distances from the ditch. A nomogram gives seepage rates when no impermeable barrier is present and infinitely wide spacing is used. An illustration shows that the nomograph is useful to estimate seepage rates for flow media of finite depth and width. (Knapp-W69-08576

WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968,

Nebraska Univ., Lincoln. Conservation and Survey Div.; and Geological Survey, Lincoln, Nebr. C. F. Keech, and G. R. Svoboda.

Nebr Water Survey Pap No 24, June 1969. 43 p, 7 fig, 1 tab, 15 ref.

Descriptors: *Groundwater, *Water levels, *Observation wells, *Nebraska, *Data collections, Hydrologic data, Hydrographs, Water-level fluc-

Identifiers: *Periodic observations.

Water level data from the Nebraska observation well network for 1968 are tabulated. Hydrographs and contour maps show water levels and fluctuations. Each well record shows location, period of record, water levels, and change in water levels. Most of the measurements were made in the Fall, after the close of the irrigation season. (Knapp-W69-08588

GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY HOLE, GAR-FIELD COUNTY, COLORADO,

Geological Survey, Denver, Colo. Paul T. Voegeli, Sr.

Geol Surv Open-file Rep, Apr 4, 1969. 17 p, 4 fig, 4 tab, 1 ref. Contract No AT (29-2)-474 (AEC).

Descriptors: *Hydrogeology, *Water wells, *Aquifers, *Colorado, Water yield, Transmissivity, Permeability, Water levels, Groundwater basins, Discharge (Water). Identifiers: *Garfield County (Colo), *Test holes,

Drillstem tests, Aquifer testing.

Hydrologic tests on the Rulison exploratory hole, Garfield County, Colo., indicated that little or no water occurs in the Ohio Creek Conglomerate and Mesaverde Group which are the stratigraphic units most likely to yield water to the hole. Six depth intervals, beginning at 6,129 ft and ending at 8,018 ft, were tested. Pressures recorded during the testing

Field 02—WATER CYCLE

Group 2F—Groundwater

of the individual zones indicated little or no fluid entry while the test tool was open. (USGS) W69-08596

WATER RESOURCES AND DEVELOPMENT: WATER RESOURCES.

Geological Survey, Portland, Oreg. For primary bibliographic entry see Field 02E. W69-08604

2G. Water in Soils

SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN SOUTHERN CALIFORNIA,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. R. M. Rice, E. S. Corbett, and R. G. Bailey. Water Resources Res, Vol 5, No 3, pp 647-659, June 1969. 13 p, 1 fig, 7 tab, 18 ref.

Descriptors: *Mass wasting, *Soil-water-plant relationships, Landslides, Saturation, Hydraulic conductivity, Soil texture, Vegetation, Topography, Soil conservation, Soil mechanics.

Identifiers: *San Dimas Experimental Forest (Calif), Soil slips.

Soil slippage, a form of shallow mass soil move-ment, was studied on the San Dimas Experimental Forest in southern California after several large storms in 1965 and 1966. The 3-part study consisted of analyzing topographic data from 200 random points measured photogrammetrically; measuring soil texture, soil depth, wettability of surface soil, and hydraulic conductivity of slip surface on slipped and stabel sites; and mapping and analyzing soil slips to assess the effects of watershed variables. All slips occurred on slopes greater than 80% The occurrence of slips was inversely related to the size and density of vegetation. In brush areas, northerly aspects were more stable than southerly ones. Conversion from brush to grass on the experi-mental forest may have resulted in an additional 135 cu m/ha of soil slip erosion during the winter of 1965-1966. (Knapp-USGS) W69-08201

THE VERTICAL MOVEMENT OF WATER IN STRATIFIED POROUS MATERIAL. TRANSIENT STAGES OF DRAINAGE TO A WATER TABLE, Cambridge Univ. (England). School of Agricul-

M. Bybordi.

Water Resources Res, Vol 5, No 3, pp 694-697, June 1969. 4 p, 1, fig, 1 tab, 4 ref.

Descriptors: *Infiltration, *Seepage, *Percolation, Saturated flow, Unsaturated flow, Wetting, Submergence, Hydraulic conductivity, Soil water movement, Water yield, Model studies, Hydraulic models, Mathematical studies, Water table. Identifiers: Vertical soil water flow

An equation is derived using the Green and Ampt concept to describe the yield of water at a given time from a freely draining composite column of initially saturated porous materials in a gravitational field. The equation is supported by experimental results. The agreement between computed and ob served curves of drainage from composited columns is fairly satisfactory but not as good as in the case of infiltration. The reason is in part because the shape of the moisture profile for drainage is less abrupt than for infiltration, so that the condition for the validity of the Green and Ampt approximation is not so well satisfied. At the same time the less well defined water front introduces greater experimental uncertainties. The air entry pressure exhibits hysteresis and is greater for drying than for wetting; during wetting the whole pore space must be filled from dryness to saturation, whereas drainage releases only a portion. When the coarser sand is at the bottom the water front comes to rest in a lower position than

when the finer sand is below the coarser. (Knapp-USGS) W69-08203

ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID OF ELECTRONIC COMPUTERS (FRENCH),

Institute of Hydrotechnical Research, Bucharest (Rumania)

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 175-188, 1968. 13 p, 7 fig, 2 tab, 8 ref.

Descriptors: *Mathematical models, *Seepage, *Surface-groundwater relationships, *Digital computers, Numerical analysis, Groundwater move-ment, Darcy's law, Flow nets, Synthetic hydrology, Analog models. Identifiers: Romania

New digital computers can be used for solution of complicated seepage problems by means of numerical methods. Investigations in progress by several research workers from various countries have not been generally successful in spite of several satisfactory results obtained so far. Assuming Darcy's law is valid, the study of groundwater motion through homogeneous and isotropic permeable media consists in a single integration, known as the relaxation and overrelaxation method. The optimal overrelaxation coefficient was determined taking into account Young and Thirriot's investigations. The boundary conditions are described as well as the rational computation schemes adequate for several problems in seepage through homogeneous media. The results are given as spectra of equipotential and flow lines. A comparison of the results obtained from numerical computation on digital computers with the results provided by electric analog models shows that the analogs are still advantageous in the case of homogeneous media with simple boundary conditions. Numerical methods should substitute gradually for the conventional techniques now in use (analytical, analog, graphical, and physical models). (Knapp-USGS) W69-08231

TRACING GROUNDWATER WITH CHLORIDE IONS AND TRI KAOLINITIC SOIL, TRITIUM THROUGH ACID

Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

For primary bibliographic entry see Field 02F. W69-08286

WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY PLANTS, California Univ., Riverside.

For primary bibliographic entry see Field 03F.

FOREST DRAINAGE RESEARCH IN THE

COASTAL PLAIN,
Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station.
For primary bibliographic entry see Field 04A.

WATER TABLE, SOIL MOISTURE, AND OXYGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. For primary bibliographic entry see Field 04A.

W69-08443

HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, Forest Service (USDA), Laramie, Wyo. Rocky

Mountain Forest and Range Experiment Station. David L. Sturges.

Soil sci, 1968, 106 (4): 262-264, Illus.

Descriptors: *Hydrologic properties, *Water storage, *Moisture tension, *Bulk density, *Hydraulic conductivity, Fen, Bobs, Wyoming. Identifiers: Histosols.

Selected hydrologic characteristics of peat from a Wyoming mountain bog were measured in the laboratory and in the field. Sample depths were 0-13 and 13-25 cm. in moderately decomposed surface peat, and 36-48 cm. in decomposed peat. Bulk densities were 0.160, 0.208, 0.216, g/cc. at these depths, respectively. Water yields at these respective depths were 0.223, 0.140, and 0.076 cc./cc. between saturation and 0.10 bar suction, and 0.500, 0.458, and 0.349 cc./cc. between saturation and 1.00 bar suction. Both bulk density and water retention were related to the degree of decomposition and thus to pore size distribution. Surface peat contained large voids which emptied at low suctions, but greater suctions were required to drain the smaller pores of decomposed material. Hydraulic conductivity measured in situ at depths of 46 and 91 cm. was 23.9 x 10-3 and 16.1 x 10-3 cm. per day, respectively. W69-08456

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-D,

Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02I. W69-08460

MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE PON-DEROSA PINE STANDS,

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Sta-

Earl F. Aldon. Journal of Forestry, 66 (1): 70-71.

Descriptors: *Forest soils, Humus, Coniferous forests, Soil moisture, *Moisture deficit, Water loss, *Ponderosa pine trees.

Identifiers: *Forest floor, Litter weight, Moisture

Between 0.16 and 1.09 inches of moisture were lost from the forest floor on plots of pole-size ponderosa pine during part of the summer thundershower period in Arizona. This represented a loss of from 7 to 27 percent of gross precipitation. Stand age offered a good estimate of weight of the forest floor on these plots. W69-08461

DETRIMENTAL EFFECT OF RUSSIANTHIS-TLE ON SEMIDESERT RANGE IN WEST-CEN-TRAL NEW MEXICO,

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.

Earl F. Aldon.

US Forest Serv Res Note RM-109. 2 p.

Descriptors: *Plant growth, Vegetation effects, Grasses, *Ranges, *Land management, *Weeds, *Grasslands. Identifiers: Ground cover.

Ground cover of perennial grasses declined seriously under plots covered overwinter with dead thistle plants. Adjusted means of ground cover per 100 feet of line intercept showed the control with 5.16 feet and plots where thistle was held overwinter 2.81 feet. This difference is significant at the W69-08464

PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF NEW MEX-ICO,

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.

R. E. Campbell.

US Forest Serv Res Note RM-108. 7 p.

Descriptors: *Soils, Ranges, Grasses, Barley, *Soil moisture, *Soil science, Soil texture, *Soil-waterplant relations.

Identifiers: Ground cover.

Variability of plant cover on the Rio Puerco watershed within short distances is thought to be due primarily to availability of water. Even though the eight soils sampled varied from native to cultivated lands, from fine sands to firm clays, and from river bottoms to high plateaus, they were normal in moisture-holding capacity, pH, and other physical and chemical characteristics. W69-08465

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
Forest Service (USDA), Tempe, Ariz. Rocky

Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 04D. W69-08479

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL

COMMUNITIES, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. R. M. Garcia, and C. P. Pase.

USDA Forest Serv Res Note RM-85, 2 p, illus.

Descriptors: *Chaparral, *Soil moisture, *Shrubs, Ecology, *Soil-water-plant relationships, Canopy. Identifiers: *Litter, *Plant-water relations, Live oak, Manzanita.

Water-holding capacity of Pringle manzanita litter averaged 5.1 m., and shrub live oak litter 4.8 mm., under dense, uniform canopies. Pringle manzanita litter held more water per gram of litter than did shrub live oak (2.00 vs. 1.80), but total litter produced was less (11.2 tons per acre vs. 12.1). W69-08488

RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND FERN-COVERED AND BURNED WATERSHEDS IN HAWAII,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. H. W. Anderson, P. D. Duffy, and Teruo

Yamamoto. US Forest Service Research Paper PSW-34 (1967):

Descriptors: *Rainfall-runoff relations, *Peak discharges, *Storm runoff, *Hydrologic properties, *Watershed management, *Burning, Reforestation, Ferns, Trees, Analytical techniques, Hawaii. Identifiers: Principal components analysis.

Streamflow from two 30-acre watersheds near Honolulu was studied by using principal components regression analysis. Models using data on monthly, storm, and peak discharges were tested against several variables expressing amount and in-tensity of rainfall, and against variables expressing antecedent rainfall. Explained variation ranged from 78 to 94 percent. The analysis provided some clues as to the dominant hydrologic processes under three different watershed conditions. The lack of change in the coefficients relating precipitation to runoff in the pre- and post-fire periods may be interpreted as indicating that the burning of the watershed had little effect on the infiltration or percolating capacity--at least not in the range such as to affect rainfall excess or storm interflow or both.

On the other hand, the increase in the regression constant indicates that the burning of the watershed had its expected effect in reducing any storage that was readily available for evaporation, such as the interception storage. W69-08510

SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA FOREST SITES, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

Donald W. Willen. Proc Soil Sciences Soc of America, Vol 29, No 2 (1965): 213-218.

Descriptors: *Erosion, *Soil aggregates, *Cohesion, *Soil formation, *Laboratory tests, Soil sampling, Basalts, Igneous rocks, Vegetation effects, Humid climates, Mapping. Identifiers: Erodability, Erosion ratios.

Analyses of soil texture and potential erodibility were made on 208 samples of residual upland forest soils, collected at elevations of 6500 to 8,500 ft. Multiple regression tests showed that soil texture and erodibility indices were significantly related to variation in parent rock type, vegetative cover type, aspect, slope, elevation, and their interactions, Prediction equations imply that granitic forest soils at high elevation may be twice as erodibile as soils developed under similar soil-forming conditions at low elevations. Coefficients permitting estimations of soil texture, aggregation, dispersion ratios and surface-aggregation rates are given. W69-08513

SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE FLOW PROBLEM,

Drexel Inst. of Tech., Philadelphia, Pa. For primary bibliographic entry see Field 02F. W69-08575

2H. Lakes

DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION,
Department of Energy, Mines and Resources, Ottawa (Ontario); and McGill Univ., Montreal For primary bibliographic entry see Field 07C. W69-08242

NITROGEN FIXATION IN SOME ANOXIC

LACUSTRINE ENVIRONMENTS,
Florida Univ., Gainesville. Dept. of Environmental

Engineering.
Patrick L. Brezonik, and Carol L. Harper.
Science, Vol 164, pp 1277-1279, June 1969. 1 tab,

Descriptors: *Nitrogen fixation, *Lakes, Dystrophy, Nitrogen cycle, Eutrophication, Bacteria, Cycling nutrients, Cyanophyta, Limnology, Nitrogen compounds, Enzymes, Environmental effects, Gas chromatography, Wisconsin, Florida, Meromixis, Oxygen, Color, Temperature, Thermooline

*Anoxic environments, Acetylene reduction assay, Nitrogenases, Nitrogen-15, Nosto-cales, Lake Mary (Wis), Vilas County (Wis), Lake Mize (Fla), Alachua County (Fla), Monomixis, Heterotrophy, Kjeldahl nitrogen, Biogeochemistry, Organic nitrogen.

Utilizing an assay for nitrogenase activity involving the reduction of acetylene to ethylene, authors studied nitrogen fixation in two dystrophic lakes: Lake Mary, Wisconsin, and Lake Mize, Florida. Following range rates of nitrogen fixation (in nannorange rates of introgen tradion (in halling grams/liter/hour) indicate presence of nitrogenase and in situ fixation in these lakes: Lake Mary (28 June 1968), 3.3-46.6. Lake Mize (11 July 1968), 83-308; 21 August 1968, 0.0-83.3. Maximum fixa-

tion occurred in both lakes in aphotic and anoxic environment: at 20 meters in Lake Mary, and in Lake Mize at 9.1 meters in July and at 15 meters in August. Data for total Kjeldahl nitrogen by depth in both lakes (August) and for total organic nitrogen in Lake Mize (July) are also tabulated in report. Authors cite environmental conditions in these lakes as evidence that agents of fixation were probably bacteria rather than cyanophytes. It is suggested that if similar rates of fixation are widespread in anoxic lake water and lacustrine sediments, estimates of the role of fixation in global nitrogen budget will have to be increased. (Eichhorn-Wis) W69-08280

THE 'WORKING' OF THE MADISON LAKES,

William Trelease

Wisconsin Acad Sci, Arts and Letters, Vol 7, pp 121-129, 1889. I fig, I plate, 60 ref.

Descriptors: *Eutrophication, Cyanophyta, Odor, Scum, Fishing, Wisconsin, Bibliographies, Lakes, Nuisance algae, Bacteria, Water pollution effects. Identifiers: *Madison (Wis), *'Working' of lakes, *Water-bloom, 'Breaking' of lakes, Chroococaceae, Nostochineae, Clathrocystis aeruginosa, Coelosphaerium Kutzingianum, Anabaena flos aquae, Anabaena mendotae, Anabaena hassali, Lyngbya nollei, Glocotrichia pisum, Nostoc verrucosum, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Anabaena circinalis.

The Madison (Wisconsin) lakes were observed for signs of eutrophication from 1882-1887. Symptoms observed included greenish-yellow scum or fine granules suspended in water, odors associated with algal decomposition, staining of shorelines, and decreased fish biting. The algae generally appeared in mid-summer and persisted for only a few days before being broken up and dispersed by breezes. Such phenomena have been referred to as the Such phenomena have been retrieved to a the 'working' or 'breaking' of lakes and are synonymous with the European term 'water-bloom'. The symptons, caused by the occurrence of members of the algae group Cyanophyceae, are favored in stagnant water bodies and usually occur after prolonged hot spells. The two principal subdivisions of the group are Chroococcaceae and Nostochineae. Of the former, Clathrocystis aeruginosa and Coelosphaerium Kutzingianum were the principal problem species in the Madison lakes, and from the latter, Anabaena flos aquae and Anabaena circinalis were most common. Anabaena mendotae, which is more tolerant of cold, predominates late in the season. Paper includes a list of sixty references on water-blooms. Only principal papers treating recurrence of bacteria in quantity are included, most of them have little botanical value but serve as a nucleus for other references available in 1889. (Ketelle-Wis) W69-08283

HEAT BUDGET OF AN ICE COVERED INLAND LAKE,

Wisconsin Univ., Madison. Dept. of Meteorology.

Jon T. Scott, and Robert A. Ragotzkie. Technical Report No 6, Series to Lakes and Streams Investigations Committee, Oct 1961. 41 p, 15 fig, 13 tab, 23 ref. ONR Contract No: 1202 (07). NR 387-022.

Descriptors: *Heat budget, *Ice, *Lake, *Conduction, Heat transfer, Latent heat, Heat exchange, Radiation, Albedo, Absorption, Advection, Estimating, Air, Water, Snowcover. Identifiers: Lake Mendota.

The heat budget for Lake Mendota is evaluated for two winter seasons. Winter is defined as extending from the time just before freezing of the lake surface until all ice has melted in the spring. Change in heat storage, radiation flux, conduction (molecular and/or eddy) and advection are determined separately for snow, ice, and water where applicable. Sensible and latent heat flux at the lake surface are not directly measured, but the heat budget

Field 02-WATER CYCLE

Group 2H—Lakes

method appears to be promising for determining at least their sum. Aerial and lake surface measurements of albedo are compared with each other and to visual estimates of albedo based on ice or snow conditions and age of the snow surface. Results indicate that visual estimates by experienced observers are reliable within 10 percent. Heat conduction in the snow-ice-complex is measured using a thermocouple and flux-plate assembly. Seven distinct periods of the winter season are described using the heat budget data for the two years. Net radiation, air temperature, and amount and type of snow cover are the most important factors affecting the heat budget of the winter lake. (Sherman-Vanderbilt) W69-08404

SELECTIVE WITHDRAWAL FROM DENSITY -STRATIFIED RESERVOIRS,

California Inst. of Tech., Pasadena. For primary bibliographic entry see Field 05C. W69-08419

PRODUCTION OF JUVENILE STEELHEAD TROUT IN A FRESHWATER IMPOUNDMENT, Oregon State Game Commission, Corvallis. research Div.

Andre G. Coche

Ecological Monographs, Vol 37, No 3, pp 201-228, Summer 1967. 13 fig, 18 tab, 69 ref, 2 appendices,

Descriptors: *Biomass, *Fish populations, *Growth rates, *Impounded waters, Food habits, Limnology, Mortality, Trout, Oregon.
Identifiers: *Net production, *Salmo gairdneri, *Steelhead trout, *Yield, Aquatic insects, Forage ration, Mortality rates, Littoral fauna, Whistler's Pand Impoundment Oregon. Bend Impoundment, Oregon.

The concept of rearing steelhead trout in controlled impoundments has arisen from increasing civilization pressure on areas of natural production. Production of juvenile steelhead trout was studied in relation to temperature and food supply in a 13.3 hectare (ha) impoundment. Over 302 days (by 15day periods), the stock of 102,000 fish showed instantaneous mortality rates, i, of 0.003-0.117 (total 0.986), total production of 619 killograms (kg) and net production (total minus mortality) of 363 kg (28 kg/ha). Fork length-weight relationship: log W= -2.07+ 3.06 log L; condition factor, K, (with standard errors indicated in parentheses) ranged from 0.89 (0.013) to 1.14 (0.033), remaining greater than 1.0 in summer and less than 1.0 in winter; peak values occurring in August. Instantaneous rate of growth in weight, g, for entire period was 3.6, 88% of this was elaborated in the summer. Trout fed mainly on benthic insects (Chironomidae, Callibaetis, Anisoptera), with crustacean zooplankton being only occasionally important. Changes in growth rate over 15-day periods appeared to be related to feeding habits rather than temperature. Tabular data include population statistics and comparisons of growth rates, production, survival, and yield obtained from several studies. (Voigtlander-Wis) W69-08517

MORPHOMETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF LARGE LAKES,

Saskatchewan Univ., Saskatoon.

D. S. Rawson. Verh int Verein theor Limnol, Vol 12, p 164-175, 1955. 5 fig, 3 tab, 15 ref, disc.

*Oligotrophy, *Eutrophication, *Lakes, *Lake morphology, *Productivity, Plankton, Bottom fauna, Fish production, Trophic level, Regression analysis, Estimating equations Identifiers: Lake depth, Deep lakes, Shallow lakes, Canada, Lake size.

A quantitative demonstration that deep lakes are usually less productive than shallow ones is provided. Mean depth, regarded as best single index to morphometric conditions, is plotted against dry weight of plankton, bottom fauna and fish production for several lakes in western and central Canada. Analysis of regression were used to produce formulas describing the theoretical relationship between mean depth to the biological parameters. Deviations of the actual amounts of these materials from those expected theoretically appear to be attributable to the modifying effects of climatic or edaphic conditions. (Bortleson-Wis) W69-08519

STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRAN-

Yale Univ., New Haven, Conn. Osborn Zoological Lab.

G. E. Hutchinson, and Anne Wollack. Amer J Sci, Vol 238, No 7, p 493-517, July 1940. 4 fig, 3 tab, 21 ref.

Descriptors: *Connecticut, *Chemical analysis, *Lakes, *Sediments, *Eutrophication, Paleolim-nology, Sedimentation, Cores, Ecology, Diagene-sis, Organic matter, Pollen, Phosphorus, Productivity, Inorganic compounds.

Identifiers: *Linsley Pond (Conn), Lignin, Trophic equilibrium, Glacial history, Paleoecology, North

Branford.

Several inorganic and organic constituents were determined on a 43-foot core from Linsley Pond, a small eutrophic lake in Connecticut. The upper 36 feet consisted of a coarse detrital ooze, followed by a transition to a silty clay, which became dominant below 40 feet. The total ash and organic content of the sediments was very uniform throughout the consolidated ooze from 3 to 34 feet. Considerable increase in the inorganic content in the most recent unconsolidated sediment at the top of the profile is taken to indicate increased erosion of cultural origin. The distribution of organic matter in the profile is believed to indicate a rapid change from oligotrophy to eutrophy, followed by a long period of approximate equilibrium in a eutrophic condition. Several measures of organic matter in the sedimentary column were plotted according to two limiting assumptions: (1) that unit thickness of sediment was deposited in unit time, and (2) that unit mass of inorganic sediment was laid down in unit time. The time scale constructed by both methods of analysis revealed an apparent logarithmic increase in organic matter in the region between 43 and 30 feet. It is suggested that the mode of development is characteristic of a growthcurve for organisms. The nature of the trophic equilibrium is examined in relation to nitrogen and phosphorus content of the mud. (Bortleson-Wis) W69-08521

PALEOLIMNETIC SALINITY OF DZUNGAR

AND ORDOS BASINS, Shao Hung-shuen, and Huang Ti-fan. Int Geol Rev, Vol 11, No 4, pp 461-470, Apr 1969. 10 p, 2 fig, 4 tab, 8 ref. Transl from Acta Geol Sinica, Vol 45, No 3, pp 337-347, 1965.

Descriptors: *Paleolimnology, *Paleoclimatology, *Lakes, Water quality, Salinity, Paleohydrology, Salts, Evaporation, Water chemistry, Chlorides. Identifiers: *Paleosalinity, *China, Dzungar, Oratherical Company (1988)

Among geochemical methods available for determination of salinity of paleo water basins, the chlorine-content method, chloro-bromine coefficient method, and salinity coefficient method are considered most effective. The boundary between fresh water and brackish water sediments is marked when the chlorine content of mudstone is 0.02% and the chlorine-bromine coefficient 20 (salinity coefficient being around 1.5); the boundary between brackish and semi-saline sedimentation is recognized when they reach respectively to 0.12-0.15% and 80. Some Dzungar paleo lacustrine basins, during the period from Late Permian to Middle and Early Triassic age had been filled with fresh water at the earlier stage, with brackish water during the intervening and later stages. Two salinization cycles show correlation with the evolution of the paleo climate. The evolution of salt content in the paleo lakes of Ordos is quite different from Dzungar lakes. They were of fresh water during the Permian and middle Early Triassic, but during the Early Permian the water was relatively salty and became somewhat fresh thereafter. There were together two fresh cycles. The difference in evolution of water properties of these 2 lake basins is considered to be the logical consequence of their respective actual geological environment and the confinement of the lake basins. (Knapp-USGS) W69-08594

2I. Water in Plants

EFFECTS OF EXTERNAL SALT CONCENTRA-TIONS ON WATER RELATIONS IN PLANTS: IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC WATER POTENTIAL DIF-FERENCES BETWEEN ROOT XYLEM AND EXTERNAL MEDIUM,

California Univ., Riverside. Dept. of Soils and Plant

J. J. Oertli, and W. F. Richardson. Soil Sci, Vol 105, No 3, pp 177-183, 1968. 7 p, 7 fig, 10 ref.

Descriptors: *Salinity, *Osmotic pressure, *Hydro-static pressure, Circulation (Plants), Plant physiology, Transpiration, Moisture uptake, Microenvironment, Soil-water-plant relationships, Irrigation effects, Root zone, Zylem.

Experiments on sunflower plants and tomato plants show that variations of the osmotic potential difference between root xylem and external medium are nearly compensated for by variations of the hydrostatic potential difference, so that their sum stays nearly independent of external-solution concentrations having osmotic potentials of 0 to -5 bars. Increasing salt concentrations only altered this relationship slightly, while reducing transpiration rates substantially. This absence of proportionality between transpiration rate change and change in the net osmotic-hydrostatic potential differences is probably the result of a solute accumulation at the root surface and in the root free space. Other explanations include change of root permeability for water, due to the salinity, or systematic error in experimental procedures. (Sherbrooke-W69-08291

STOMATAL INFILTRATION MEASUREMENTS AS AN INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON,

National and Univ. Inst. of Agriculture, Rehovoth For primary bibliographic entry see Field 03F. W69-08293

WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS,

National Research Centre, Cairo (Egypt). For primary bibliographic entry see Field 03F. W69-08303

FOREST SITE AMELIORATION IN THE COASTAL FLATWOODS OF MISSISSIPPI, Mississippi State Univ., State College. School of Forest Resources. For primary bibliographic entry see Field 04A. W69-08397

EFFECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOL-SEASON FORAGE SPECIES,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and

Water in Plants—Group 21

Alabama Agricultural Experiment Station, Au-

Orus L. Bennett, and Basil D. Doss. Agronony Journal, Vol 52, p 204-207, 1960, 4 p. 3 fig, 2 tables; 8 ref.

Identifiers: *Rooting depth, Moisture level, Moisture extraction patterns, Core samples, Monolith samples.

The effects of 3 soil moisture levels - produced by irrigation when 30, 65, or 80% of the available soil moisture had been removed in the root zone - on root development of 8 cool-season forage species were determined. Root patterns were characterized by taking 3-inch core samples, soil monolith samples, and soil moisture extraction patterns. The amount of roots and the rooting depth varied with the species and soil moisture level. The effective rooting depth decreased as soil moisture level increased. Roots from core samples show that over 70% of the total weight of roots were found in the surface 12 inches of soil for all species except tall fescue. Soil moisture extraction was used with reasonable accuracy to estimate effective rooting depths. (Bennett-USDA Agricultural Research Service) W69-08425

SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION FROM WARM SEASON PERENNIAL FORAGE SPECIES,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Auburn.

For primary bibliographic entry see Field 02D. W69-08426

EFFECTS OF SOIL MOISTURE REGIME ON YIELD AND EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE SPE-

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 02D. W69-08427

EFFECTS OF SOIL MOISTURE REGIME ON NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 02D. W69-08429

EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 02D.

W69-08430

MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, Agricultural Research Service, Thorsby, Ala. Soil

and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 02D W69-08431

MOISTURE USE BY FORAGE SPECIES AS RE-LATED TO PAN EVAPORATION AND NET

RADIATION,
Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

B. D. Doss, O. L. Bennett, and D. A. Ashley Soil Science, Vol 98, No 5, p 322-327, 1964. 6 p, 3 fig, 2 tables, 15 ref.

Descriptors: *Water requirements, Moisture use, Evapotranspiration, Soil moisture, Pan evapora-

Identifiers: *Net radiation, Greenville fine sandy

Moisture-use rates were determined for alfalfa, coastal bermudagrass, and sorghum on Greenville fine sandy loam at Thorsby, Alabama. These rates varied with season of year, available soil moisture, stage of plant growth, and species. Moisture-use rates determined from gravimetric soil sampling throughout the growing season for each species were correlated separately with open pan evaporation and the evapotranspiration equivalent of net radiation. These correlations indicate that either open pan evaporation or net radiation may be used to estimate moisture use of forage crops under conditions where moisture is not limiting provided a relationship has been established for the given species. To estimate moisture use on a daily basis, the appropriate ET/E or ET/Rn ratio is multiplied by the measured daily pan evaporation or the evapotranspiration equivalent of net radiation. (Bennett-USDA Agricultural Research Service) W69-08432

YIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL MOISTURE, Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

Victor J. Kilmer, Orus L. Bennett, Virginia Stahly, and Donald R. Timmons.

Agronomy Journal, Vol 52, pp 282-285, 1960. 4 p, 5 tables, 7 ref.

*Soil moisture, Irrigation, Descriptors: Phosphorus, Moisture tensions.

The effect of soil moisture levels on the concentration of 12 elements was determined in field grown Atlantic and African alfalfa; red, intermediate white, and Ladino clover; fescue, reed canarygrass. and orchardgrass. The phosphorus content in all forage species increased as soil moisture supply increased but other elements were not consistently affected. (Bennett-USDA Agricultural Research Sérvice) W69-08433

EFFECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON MOISTURE USE AND YIELD OF CORN,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

B. D. Doss, O. L. Bennett, and D. A. Ashley.

B. D. Doss, O. L. Water Conservation, Vol 21, Journal of Soil and Water Conservation, Vol 21, No 3, p 99-101, May-June, 1966. 3 p, 1 fig, 3 tables, 9 ref.

Descriptors: Moisture use. Identifiers: *Conventional tillage, *Mulch tillage, Net radiation, Yields.

Corn was grown on a Faceville sandy loam soil to determine the effects of black plastic mulch, herbicide, and tillage on moisture use and yield. Average moisture-use rates were usually low while the plants were small and increased as the amount of vegetative growth increased. Maximum rates were reached during the ear development period.

Moisture-use rates during the peak-use period were similar for all treatments, but the plastic mulch reduced moisture use during the early and late parts of the growing season. Plastic mulch over the soil surface increased rate of growth, tillering, lodging, grain yield, and stover production as compared with conventional tillage. Plastic mulch increased grain yields 7 to 14 bushels per acre over conventional tillage, which averaged 80 bushels per acre. Grain yields from the lister planter treatment (mulch-tillage) averaged 83 bushels per acre and were higher than conventional tillage for 2 of the 3 years. Grain yields for the conventional-chemical and small furrow treatments with no cultivation were about the same and averaged 14 bushels per acre lower than yields for conventional tillage. (Bennett-USDA Agricultural Research Service) W69-08434

SNOW CATCH BY CONIFER CROWNS, Forest Service (USDA), Moscow, Idaho. Forestry Sciences Lab.

For primary bibliographic entry see Field 02C. W69-08436

FOREST DRAINAGE RESEARCH IN THE

COASTAL PLAIN,
Forest Service (USDA), Charleston, S. C.
Southeastern Forest Experiment Station.
For primary bibliographic entry see Field 04A.
W69-08437

DRAINAGE.

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. For primary bibliographic entry see Field 04A. W69-08438

SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION: RESEARCH FINDINGS - ORGANIC SOILS, Forest Service (USDA), Charleston, S. C. Southeasterr Forest Experiment Station

Southeastern Forest Experiment Station. For primary bibliographic entry see Field 04A. W69-08441

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-D,

Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. Ronald D. Tabler.

J Range Manage, 1968, 21 (1): 12-15, Illus.

Descriptors: *Sagebrush, *Soil moisture, *Soilwater-plant relationships, *Evapotranspiration, Herbicides, Nuclear moisture meters, Brush control, Range management, *2-4-D.

Studies of soil moisture response to herbicidal control of big sagebrush were initiated one year prior to spraying and were continued for three years after treatment. Spraying big sagebrush with 2,4-D reduced the rate of soil moisture withdrawal. About 75% of the difference in total moisture depletion occurred within the 3- to 6-ft. soil depth; an opposite effect in the second foot indicated that the increase in grass herbage production is most strongly reflected in that zone. Total evapotranspiration losses from the 0- to 6-ft. soil profile were reduced about 14% over the four-month growing period the second year after spraying. W69-08460

SUMMER DEFERRED GRAZING CAN IM-SEMIDESERT DETERIORATED **PROVE** RANGES.

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment

For primary bibliographic entry see Field 04A. W69-08462

Field 02-WATER CYCLE

Group 21-Water in Plants

DEFERRED GRAZING AND SOIL RIPPING IM-PROVES FORAGE ON NEW MEXICO'S RIO

PUERCO DRAINAGE,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.

For primary bibliographic entry see Field 04A. W69-08463

INFLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE GRASSES, Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment

Station O. D. Knipe

J Range Manage, 20: 298-299.

Descriptors: *Temperature, Range grasses, Grasses, *Ranges, *Range science, *Germination. Identifiers: Ground cover.

Boer lovegrass, galleta, and blue grama germinate relatively well within a temperature range of 60 degree to 100 degree F, but the range required for good germination of alkali sacaton and Lehmann lovegrass is limited to 80 degree to 90 degree and 60 degree to 70 degree F respectively. W69-08467

SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN COLORADO, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. H. E. Brown, and J. R. Thompson J of Forestry 1965, 63 (10): 756-760, illus.

Descriptors: *Consumptive use, *Evapotranspiration, Soil moisture, Soil-water-plant relationships, *Water utilization, Vegetation effects. Identifiers: *Water use.

Soil moisture was measured in spring and fall of 1955, 1957, and 1958 to determine relative amounts of water use on sites occupied by quaking aspen, Engelmann spruce, and mountain grassland during the summer growing season. Study plots were located on sites where the soil was deep enough to permit gravimeteric sampling to a depth of 8 feet. Water use was considered as the difference between soil moisture in the spring and fall, adjusted for summer precipitation. Aspen plots averaged 19.2 inches, spruce 14.9 inches, and grassland 8.9 inches of water use yearly for the 3 years of record. Because the amount of spring soil moisture was significantly different among types, however, and because spring moisture was correlated with water use in aspen and spruce types, it was impossible to attribute differences in water use solely to the type of vegetation. W69-08468

REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING OF OAK-MOUNTAINMAHOGANY CHAPARRAL, Forest Service (USDA), Tempe, Ariz, Rocky Mountain Forest and Range Experiment Station. Charles P. Pase, and George E. Glendening. USDA Forest Serv Res Note RM-49, illus, 1965. 2

Descriptors: *Burning, *Brush control, *Chaparral, Ecology, Succession, Erosion, Canopy, Shrubs. Identifiers: *Litter, *Prescribed burning, Live oak, Mountainmahogany, Litter reduction.

Shrubs were dried prior to burning by spraying with Dinoxol (tutoxy ethanol esters of 2,4-D and 2,4,5-T). Litter reduction varied from one-third to one-half; shrub canopy was reduced over 90 percent. W69-08470

SHRUB SEEDLING REGENERATION AFTER CONTROLLED BURNING AND HERBICIDAL TREATMENT OF DENSE PRINGLE MAN-

ZANITA CHAPARRAL,
Forest Service (USDA), Tempe, Ariz. Rocky
Mountain Forest and Range Experiment Station.
Charles P. Pase.

USDA Forest Serv Res Note RM-56, illus, 1965. 2

Descriptors: *Ecology, *Succession, *Brush control, Herbicides, Chaparral, 2-4-D. Identifiers: *Manzanita, Shrub see Regeneration.

Planned fall burning of dense manzanita chaparral was followed by large increases in seedlings of yerba-santa, Pringle manzanita, desert ceanothus, and five other brush species. Seedlings of most shrub species were virtually absent from an adjacent unburned area, and from an area sprayed with 2,4-D but not burned. W69-08471

HELICOPTER-APPLIED HERBICIDES CON-TROL SHRUB LIVE OAK AND BIRCHLEAF MOUNTAINMAHOGANY,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station.

For primary bibliographic entry see Field 03B. W69-08486

PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID RE-

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08489

WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08490

GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08491

SURFACE RESISTANCE OF CROP CANOPIES, Rothamsted Experimental Station, Harpenden (England).

For primary bibliographic entry see Field 02D. W69-08573

2J. Erosion and Sedimentation

SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS,
Agricultural Research Service, Oxford, Miss. Sedi-

mentation Lab. T. C. Muir.

Proc Miss State Univ Water Resources Res Inst Conf, State Univ Water Resources Res Inst Conf, State Coll, Apr 8-9, 1969, pp 73-83, 1969. 11 p, 3 fig, 2 tab, 10 ref.

Descriptors: *Sedimentology, *Sampling, *Statistical methods, Sediment transport, Rivers, Streams, Gravels, Sands, Dredging, Particle shape, Particle

Identifiers: Areal sampling, Volumetric sampling.

Volumetric, or bulk, sampling of river gravel normally requires considerable effort and equipment and often may not be feasible. Samples may not be representative of the sediment deposit. The depth to which the sample should be taken is usually unknown and affects the shape of the particle size distribution curve. A recommended standard

procedure for areal, or surface, sampling is selection by the grid method of particles larger than 4 mm, determination of the arithmetic mean of the triaxial dimensions of each particle, and plotting of the particle size distribution on a number frequency basis. The areal sampling technique can provide a sample representative of a large area, may be carried out in shallow water, and all measurements may be completed in the field. Areal sampling of gravel deposits can yield estimates of particle sizes usually obtained from bulk samples. The procedure may be used in studies of hydraulic roughness, channel stability, bed armoring, sediment transport and in the general classification of river processes. (See W69-08221). (Knapp-USGS) W69-08223

NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA,

All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).

D. E. Gershanovich.
Marine Geol, Vol 6, No 4, pp 281-296, Aug 1968. 16 p, 9 fig, 7 ref.

Descriptors: *Sedimentation, *Continental shelf, *Continental slope, *Oceans, *Alaska, Sedimentation rates, Provenance, Geomorphology. Identifiers: Geosynclines, Bering Sea.

Soviet marine geological surveys in the Bering Sea and Gulf of Alaska showed considerable differences in epicontinental and geosynclinal sedimentation. Epicontinental regions of the Bering Sea are covered by terrigenous sediments of different granulometry. Diatom sediments privail in the zone of the continental slope and especially in the deep zone of the Bering Sea. They are much more abundant in this area than in the neighboring areas of the north Pacific Ocean. In most of the areas of the Komandor-Aleutian island arc terrigenous deposits are prevalent. In the eastern zone of the Aleutians, both in the Bering Sea and in the Pacific Ocean, terrigenous-volcanic and volcanic deposits are abundant. In the shelf and continental slope of the Gulf of Alaska terrigenous and to a lesser degree volcanic and foraminiferous and diatomous deposits are found. Near the region of continental glaciation, glacial-marine and turbidity current sediments occur. The rate of the recent sedimentation is very high everywhere. It varies from 2 to 30 cm/1,000 yr on the shelf of the Bering Sea to 40 cm/1,000 yr in the lower inclined part of the continental slope. (Knapp-USGS) W69-08249

STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE.

Naples Univ. (Italy). Hydraulic Lab. M. Viparelli, and M. Pica.
Congress held at Ft. Collins, Coló. Proc Int Ass for

Hydraul Res, 12th Congr, Vol 1, A8, pp 57-67, 1967. 11 p.

Descriptors: *Model studies, *Alluvial channels, *Sediment transport, *Particle size, Flow rates, Profiles, Streambeds, Hydraulic properties, Slopes, Change, Sediments, Sediments, States and Sediments. Channels, Sediments. Identifiers: *Italy, Experimental research.

To find out the fundamentals of fluvial sediment transport in streams in large alluvial beds of high slope, an experimental research project was conducted at the Hydraulic Laboratory, Naples University, Italy. A sandy bottom channel, 0.60 m wide and 18 m long was employed. Systematic tests were made with sands of two textures and with three rates or water flow: 3, 1.5, and 0.75 lit/sec. Other tests were made with channel width reduced to 0.30 m. Measured_sand discharges and bottom profile changes show that the sediments and the local slopes continuously vary around their average values without apparent cause. Higher bottom slopes show a linear relation between slopes and sand discharges for each sand size and each rate of flow. For smaller slopes sand discharge decreases slowly with decreasing slope. (Lang-USGS)

W69-08258

SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, ARIZONA, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 04D. W69-08474

EROSION AND SEDIMENT MOVEMENT FOL-LOWING A WILDFIRE IN A PONDEROSA PINE FOREST OF CENTRAL ARIZONA, Forest Service (USDA) Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 04D. W69-08475

GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL GAZING IN RELATION TO MINISTRACE
EROSION ON SOME CHAPARRAL
WATERSHEDS OF CENTRAL ARIZONA,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 04D. W69-08476

ERODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS RELATED TO SOIL FORMING FACTORS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Teruo Yamamoto, and Henry W. Anderson. Water Resources Research, 3 (3), (1967):785-798.

Descriptors: *Erosion, *Soil aggregages, *Cohesion, *Soil formation, *Laboratory tests, Soil sampling, Basalts, Igneous rocks, Vegetation effects, Humid climates, Mapping, Reforestation. Identifiers: Erodability, Erosion ratios.

Sedimentation potential of wildlands. Month by month urbanization is invading Hawaii's forest lands. Many people are asking: 'Does this invasion pose a threat to the protection capacity of the watersheds.' Soil characteristics help determine the extent of allowable disturbance and the kind and intensity of conservation practices needed. Indices of soil erodibility of Oahu's wildland soils were obtained by principal component analysis of 7 characteristics which can be determined from maps and aerial photographs: geologic rock type, rainfall, elevation, vegetation type, slope, aspect and zone. Geologic parent rock was found to be the most important factor in differentiating erodibility of Hawaii wildland soils. However, the study showed that the native dominant koa-ohia was naturally high in easily eroded small aggregates. In contrast the kukui, and planted forest stands of paperbark and silk oak were consistently low in erodibility. Planting of trees which favor development of less erodible soils may be promoted. Generalized map of the erodibility of soils in Oahu was combined with a rainfall map, indicating where care in management might be most needed.

W69-08482

AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK DESIGN, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07A. W69-08497

EROSION AND SEDIMENTATION, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

Henry W. Anderson.
US Nat Rpt XIV General Assembly IUGG, Trans
Amer Geophys Union 49 (2), (1967): 697-700.

Descriptors: *Erosion control, *Sedimentation, *Sheet erosion, *Sediment transport, *Reviews, *Publications, *United States, Laboratory tests, Site laboratories, Analytical techniques, Vegetation effects, Land use. Identifiers: Land erosion.

Summarizes progress in erosion and sedimentation research in the United States during the four years 1962-1966. A computer program was used to search some 300 publications titles and keywords, under headings keyed to laboratory and flume studies; studies of soil, watershed, and land use effects; studies of mechanical control; studies of vegetative control and developments in instrumentation and techniques. 73 papers are cited. W69-08507

SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA FOREST SITES, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02G. W69-08513

STUDIES ON CONNECTICUT LAKE SEDI-MENTS. II. CHEMICAL ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRAN-FORD.

Yale Univ., New Haven, Conn. Osborn Zoological

For primary bibliographic entry see Field 02H. W69-08521

EFFECT OF SEDIMENT CONCENTRATION ON WELL RECHARGE IN A FINE SAND AQUIFER, Texas A and M Univ., College Station; and Florida Univ., Gainesville. For primary bibliographic entry see Field 02F. W69-08574

RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER FLORIDA

State Univ. of New York, Binghamton. Dept. of Geology. For primary bibliographic entry see Field 02L. W69-08577

THE SIGNIFICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND MODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN, Goldsmiths' Coll., London (England). Dept. of Geology and Geography; and Georgia Univ., Sanelo Island, Marine Inst.

Sapelo Island. Marine Inst. For primary bibliographic entry see Field 02L. W69-08578

EROSIONAL CURRENT MARKS OF WEAKLY COHESIVE MUD BEDS,

Reading Univ. (England). Sedimentology Research Lab. J. R. L. Allen.

J Sediment Petrol, Vol 39, No 2, pp 607-623, June 1969. 17 p, 18 fig, 1 tab, 28 ref.

Descriptors: *Erosion, *Mud, *Sedimentary struc-Descriptors: Erosion, *Mud, *Sedimentary struc-tures, *Scour, *Turbulent flow, Regime, Deltas, Sediment-water interfaces, Ripple marks, Stream-flow, Stream erosion, Model studies, Hydraulic models, Flow separation.

Identifiers: Flute marks, Weakly cohesive sedi-

The manner in which a bed of weakly cohesive mud is eroded by a plain, turbulent flow of water is found experimentally to depend on the severity of the flow over the bed. The major structures left behind on a weakly cohesive mud bed after a prolonged period of erosion also depend on the severilonged period of erosion also depend on the severity of flow. With ascending severity, we obtain: (1) longitudinal rectilinear grooves, (2) longitudinal meandering grooves, (3) flute marks, and (4) transverse erosional markings. The more severe flows also give rise to shear wrinkles and to erosional structures of a less well defined nature. Of the 4 structures, all but longitudinal rectilinear grooves have counterparts in the fossil record. Of

particular importance is evidence confirming that flute marks are associated with separated flows and are due to processes of flow separation and reat-tachment. (Knapp-USGS) W69-08579

THE SEDIMENTOLOGY OF A BRAIDED

RIVER, Ottawa Univ., Ontario. Dept. of Geology. Peter F. Williams, and Brian R. Rust. J Sediment Petrol, Vol 39, No 2, pp 649-679, June 1969. 31 p, 28 fig, 5 tab, 22 ref, 2 append.

Descriptors: *Sedimentology, *Rivers, *Braiding, Meanders, Deposition (Sediments), Alluvium, Aggradation, Erosion, Particle size, Particle shape, (Water), Streamflow, Channel Clays, Sands, Silts, Gravels, Mud, Discharge morphology, Clays, Sands, Silts, Gravels, Mud, Regime, Ripple marks, Sedimentary structures, Sand waves

Identifiers: *Canada, Sedimentary facies, Yukon.

A straight, 4-mile tract of the Donjek River, Yukon, Canada is braided throughout, discharging about 50,000 cfs in flood. The active part of the tract shows upper regime flow in the main channels, and lacks vegetation. Higher, older levels are former river courses, partly or completely vegetated, with continuous flow (principally lower regime) only in the main channels. Comparing channel (width; depth) and topographic indices the younger surfaces are more strongly dissected because of active channel cutting, whereas channels on older levels are subject to infilling. The sediments vary from clays to coarse gravels; most are poorly sorted. CM plots permit division into 3 main groups: silt and mud of low energy environments such as abandoned channels, gravel of high energy channel-bar complexes, and a variable in-termediate group which fills channels under medium-energy conditions. Seven facies are distinguished on textural, floral, and sedimentary structural characteristics. Facies relations are mostly gradational within channels, commonly fining upwards. They are more complex between channels, and invariably erosional. The origin and directional significance of hierarchical orders of sedimentary structures were studied. Six hundred and sixty measurements of small-scale structures (mostly ripples) show moderate within-bar and between-bar varia-tion, and give a grand vector mean 22 deg. from the river trend. Bisectors of channel directional arcs (maximum and average ranges) approximate the river trend within 5 deg. (Knapp-USGS) W69-08580

PRECIPITATION AND LITHIFICATION OF

DEEP-SEA CARBONATES IN THE RED SEA, Woods Hole Oceanographis Institution, Mass. John D. Milliman, David A. Ross, and Teh-Lung

J Sediment Petrol, Vol 39, No 2, pp 724-736, June 1969. 13 p, 14 fig, 2 tab, 41 ref.

Descriptors: *Sedimentation, *Diagenesis, *Water *Water chemistry, Carbonates, Calcite, quality, *Water chemistry, Carbonates, Calcite, Sands, Silts, Mud, Deposition (Sediments), Chemical precipitation, Sea water, Evaporation, Salinity, Trace elements.
Identifiers: *Red Sea, Aragonite.

More than one-half of the deep-sea carbonates in the Red Sea are estimated to have been inorganically precipitated. Aragonite-cemented layers were formed during glacially lowered stands of sea level, when Red Sea waters were highly saline. Some magnesian calcite lithic fragments might represent inversion products of aragonite; others are believed to have been precipitated directly from normal Red Sea water. Chemical mineralogical and petrographic similarities with lithic fragments suggest that the magnesian calcite portion of the Red Sea lutite was also inorganically precipitated. Similar inorganic carbonate precipitation probably occurred in the Mediterranean Sea, during glacially lowered sea level. (Knapp-USGS) W69-08581

Group 2J—Erosion and Sedimentation

AN INEXPENSIVE RECORDING SETTLING TUBE FOR ANALYSIS OF SANDS,

University of Southern California, Los Angeles. For primary bibliographic entry see Field 07B. W69-08582

CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SETTLING TUBE,

University of Southern California, Los Angeles.

Dept. of Biology. For primary bibliographic entry see Field 07B. W69-08583

A CONTACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTI-CLES,

Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics; and National Iranian Oil Co., New York

For primary bibliographic entry see Field 07B. W69-08584

A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL FRAGMENTS,

Ibadan Univ. (Nigeria). Dept. of Geology For primary bibliographic entry see Field 07B. W69-08585

A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO SEDIMENTS,

Department of Energy, Mines and Resources, Burlington (Ontario). Canada Centre for Inland Waters

R. L. Thomas.

J Sediment Petrol, Vol 39, No 2, pp 803-809, June 1969. 7 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Sediments, *Lake Erie, *Lake Ontario, *Organic matter, Clays, Sands, Silts, Carbon, Organic compounds, Great Lakes, Deposition (Sediments), Quartz, Sedimentation, Particle shape, Particle size.

Identifiers: Great Lakes sediments.

An examination of the geochemistry of fine-grained sediments in relation to size frequency distribution was carried out on sediment samples from Lakes Erie and Ontario. This study demonstrated a direct relationship between the under 2 micron grain size and the theoretical clay content computed from the organic carbon, quartz and carbonate content. A sympathetic relationship was observed between clay content and organic carbon, and also between median grain size and quartz content. The former relationship is believed to be the result of absorption from solution and the latter is brought about by natural sedimentation from suspension. (Knapp-USGS) W69-08586

DISPERSION OF SILT PARTICLES IN OPEN CHANNEL FLOW.

Iowa Univ., Iowa City. Inst. of Hydraulic Research. William W. Sayre.

ASCE Proc, J Hydraul Div, Vol 94, No HY3, Pap 6579, pp 1009-1038, May 1969. 30 p, 13 fig, 2 tab, 15 ref, append.

Descriptors: *Sediment transport, *Suspended load, *Model studies, *Mathematical models, *Dispersion, Digital computers, Hydraulic models, Tracers, Diffusion, Turbulent flow, Open-channel flow, Sediment transport, Silts, Equations. Identifiers: Shear flow, Silt suspensions.

The dispersion process for sediment particles in a 2-dimensional turbulent shear flow is formulated in 2 differential equations, 1 for particles suspended in the flow and the other for those deposited on the bed. Exchange of particles between the bed and the flow is permitted. Using the Aris moment transformations, the equations are converted to a more tractable system of equations which are solved by numerical methods with the aid of a digital computer, for the zero, first, second and third moments of the longitudinal concentration distributions. Various combinations of boundary and other input conditions are imposed and their effects on the dispersion process are demonstrated. The results of the numerical solutions together with the results of earlier dispersion experiments with silt particles and fluorescent dyes show that the tendency of the silt particles toward deposition and temporary storage on the bed can profoundly affect the longitudinal dispersion process. (Knapp-USGS) W69-08592

ELECTRON MICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL ABRASION FEATURES ON QUARTZ SAND GRAINS,

Florida State Univ., Tallahassee. Dept. of Geology. Stanley V. Margolis.

Sediment Geol, Vol 2, No 4, p 243-256, Dec 1968. 14 p, 13 fig, 1 tab, 18 ref.

Descriptors: *Beaches, *Sands, *Abrasion, *Pitting (Corrosion), *Quartz, Waves (Water), Weathering, Corrosion, Electron microscopy, Chemical properties. Identifiers: Quartz grain etching.

Crystallographically oriented etch pits have been observed on quartz sand grains from marine environments, using an electron microscope. Similar features have been produced by etching quartz in the laboratory with hydrofluoric acid and sodium hydroxide. Examination of quartz sand grain surfaces from beaches of different wave intensities along the Atlantic and Gulf coasts of the United States suggests a relationship between the effects of such chemical solution features and mechanical abrasion on sand grains. Sand grains from beaches with low wave activity exhibit oriented etch pits readily attributed to the solution of quartz by sea water. These features are the surface expression of defects within the crystal. Sand grains from beaches with moderate wave energy show a combination of chemical etch features and those phenomena thought to be caused by grain-to-grain impacts, while grains from high-energy beaches predominantly show impact features. If the correlations shown by the results are valid, the relative number of chemical and mechanical features on sand grains can be used to determine energy conditions along ancient shorelines. (Knapp-USGS) W69-08607

'PEBBLE CLUSTERS': THEIR ORIGIN AND UTILIZATION UTILIZATION IN PALAEOCURRENTS, THE STUDY

Ferrara Univ. (Italy). Inst of Geology. Renzo Dal Cin.

Sediment Geol, Vol 2, No 4 p 233-241, Dec 1968. 9 p, 5 fig, 12 ref.

Descriptors: *Sediment distribution, *Bed load, *Gravels, *Paleohydrology, *Sediment transport, Sedimentation, Sediment load, Running waters, Distribution patterns, Deposition (Sediments), Sedimentary structures. Identifiers: *Pebble clusters, *Paleocurrent indica-

'Pebble clusters' are characteristic of some coarse, poorly-sorted fluvial deposits; they form when pebbles in the course of transport are stopped by cobbles or boulders protruding from the river bed. In this way wake-like piles of coarse particles accumulate in front of the obstacle which stopped them. Pebble clusters' offer excellent indications of the direction of the current, because they are always parallel, or nearly so, to the direction of the current and because the wake is almost always upstream and the boulder downstream. Furthermore, their presence in conglomerates of unknown origin offers evidence of unidirectional transport and excludes beach deposits. Finally, 'pebble clusters' are also a clue to the mode of deposition of the particles; clusters require selective transport rather than mass transport. (Knapp-USGS) W69-08608

2K. Chemical Processes

Fe, Mn, Ni, Co, Sr, Li, Zn, and SILICA IN STREAMS OF THE LOWER KANSAS RIVER

BASIN, Kansas State Geological Survey, Lawrence; and Kansas Univ., Lawrence.
For primary bibliographic entry see Field 05A.

PLANT NUFRIENTS IN BASE FLOW OF STREAMS IN SOUTHWESTERN WISCONSIN, Wisconsin Univ., Madison. For primary bibliographic entry see Field 05B. W69-08205

SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION: THEIR IM-PLICATION ON DIAGENESIS,

Georgia Univ., Athens. Dept. of Geology. Hartmut U. Wiedemann.

Chem Geol, Vol 4, No 3-4, pp 393-409, June 1969. 17 p, 5 fig, 3 tab, 21 ref. NORN-552 (07)-ONR.

Descriptors: *Chemical precipitation, *Water chemistry, *Lithification, *Diagenesis, *Evaporation, Sea water, Calcite, Carbonates, Gypsum, Limestones, Salts, Magnesium, Tides, Leaching. Identifiers: *Bimini (Bahamas).

When sea water is trapped and evaporated in the intertidal zone of tropical coasts, calcium carbonate precipitates as consequence of increasing concentrations. The precipitation takes place only on surfaces where calcium carbonate is already present. Beachrock formation on Bimini, Bahamas, can be attributed entirely to precipitation of aragonite cement from sea water. Because of the low solubility of calcium salts as compared with higher solubility of halite and magnesian salts, a chemical separation of calcium and magnesium takes place during evaporation of sea water as well as upon dissolution of sea salt in rain water. Dissolution of sea salt yields magnesium-rich solutions with initial pH values above 9 over a wide range of concentrations prior to equilibration with the atmospheric carbon dioxide. The counterpart of these magnesium-rich solutions is rich in calcium, exhibits pH values around pH 8 and tends to decompose unstable magnesian-calcite and to precipitate calcium carbonate and gypsum during expropriation. The tendency for calcium sulfate to evaporation. The tendency for calcium sulfate to precipitate in an early stage of evaporation but to redissolve readily makes gypsum a convenient short-term depot for calcium ions in intertidal and supratidal environments. (Knapp-USGS) W69-08218

DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SMALL WATERSHED, Geological Survey, Washington, D. C.

For primary bibliographic entry see Field 07C. W69-08234

ALGAE: AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS, California Univ., San Diego, La Jolla. Inst. of Marine Resources.

Osmund Holm-Hansen. Science, Vol 163, pp 87-88, January 1969. 1 fig, 19

Descriptors: *Algae, *Carbon, *Carbon cycle, *Cytological studies, Cultures, Fluorometry. Biomass, Oceanography.
Identifiers: *DNA, *Organic carbon, *Cell size,

Eukaryotes, Monochrysis lutheri, Navicula pellicu-

losa, Gonyaulax polyedra, 3,5-diaminobenzoic acid dihydrochloride, Infrared gas analysis, Coulter counter, Euglena gracilis, Cachonina niei, Skeletonema costatum, Dunaliella tertiolecta, Amphidinium carteri, Syracosphaera elongata, Thalassiosira fluviatilis, Ditylum brightwellii, Biological oceanography, Ecological techniques.

Utilizing infrared gas analysis for carbon and Utilizing infrared gas analysis for carbon and fluorometry for desoxyribonucleic acid (DNA), author analyzed the following variously sized species of unicellular algae: Monochrysis lutheri, Navicula pelliculosa, Gonyaulax polyedra, Cachonina niei, Skeletonema costatum, Dunaliella tertiolecta, Amphidinium carteri, Syracosphaera elongata. Thalassiosira fluviatilis. Ditylum brightwellii. Carbon content varied from 10 to 6000 picograms per cell, and total cellular DNA is directly proportional to cell size. Content of DNA is equal to approximately 1-3% of cellular organic carbon. Data and relationships developed in this study suggest that DNA-determinations are of potential value in determining living biomass in ecological studies. (Eichhorn-Wis) W69-08278

INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID BASIN ARIZONA, U.S.A.,

Geological Survey, Tucson, Ariz. Water Resources

For primary bibliographic entry see Field 02F. W69-08300

WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG, Forest Service (USDA), Laramie, Wyo. Rocky

Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 05B. W69-08455

GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 05B. W69-08457

NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE

GREAT LAKES,
Michigan Univ., Ann Arbor. Dept. of Meteorology
and Oceanography.
For primary bibliographic entry see Field 05A.
W69-08562

PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN THE RED SEA, Woods Hole Oceanographis Institution, Mass. For primary bibliographic entry see Field 02J. W69-08581

A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO SEDIMENTS, Department of Energy, Mines and Resources, Burlington (Ontario). Canada Centre for Inland Waters

Waters.

For primary bibliographic entry see Field 02J.

PALEOLIMNETIC SALINITY OF DZUNGAR

AND ORDOS BASINS, For primary bibliographic entry see Field 02H. W69-08594

ELECTRON MICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL ABRASION FEATURES ON QUARTZ SAND GRAINS, Florida State Univ., Tallahassee. Dept. of Geology For primary bibliographic entry see Field 02J.

W69-08607

2L. Estuaries

SOLUTIONS INTERTIDAL SUPRATIDAL ENVIRONMENTS OF MODERN PLICATION ON DIAGENESIS, Georgia Univ., Athens. Dept. of Geology. For primary bibliographic entry see Field 02K. W69-08218 CARBONATE SEDIMENTATION: THEIR IM-

NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).

For primary bibliographic entry see Field 02J. W69-08249

DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND MON-

ROVIA (FRENCH). Office de la Recherche Scientifique et Technique

Outre-Mer, Paris (France).
J. R. Donguy, and M. Prive.
Cah O.R.S.T.O.M., Ser Oceangr, Vol 6, No 2, pp
47-51, 1968. 5 p, 14 fig, 18 ref.

Descriptors: *Hydrologic properties, *Estuarine environment, Dynamics, Salinity, Seasonal, Sea water Thermocline, Isotherms, Temperature, Topography, Pressure, Winds, Mapping, Currents (Water). Identifiers: *Africa, Ivory Coast, Grain Coast.

The coastal water hydrologic regime between Abidjan and Monrovia, Africa, is described. Data were collected by the R/V 'Reine Pokou' of the Center of Oceanographic Research off the Ivory Coast during 1964 expedition. The article contains maps of salinity, surface water temperature, isotherms, thermoclines, and surface topographic dynamics. Far away from the coastal strip, the hydrographic conditions are identical with those of the South Atlantic. Some dissimilarity was found between the seasons of the Ivory Coast and the Grain Coast. (Gabriel-USGS)

ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS. Water Resources Engineers, Inc., Walnut Creek,

Gerald T. Orlob.

W69-08255

Proc, Nat Symp Anal Water Resource Syst, pp 341-358, Denver, July 1968. 18 p, 9 fig.

Descriptors: *Estuarine environment, *Networks, *Hydrodynamics, *Systems analysis, *Quality control, Mathematical models, Hydrologic properties, Advection, Diffusion, Water resources, Time, Discharge (Water). Identifiers: *San Francisco Bay-Delta System, Austelia

A technique for representing the complex hydrodynamic behavior of estuarial environments through a mathematical model comprised of a network of one dimensional channel elements was described. The equations of motion for each element and of continuity for each node in the network were solved over a time continuum to produce a dynamic response to tides and hydrologic flumes imposed at the boundaries of the model. Histories of discharge, velocity, area and tidal elevations were generated for each element or node in the system and supplied as input informa-tion to a compatible water quality model. Quality behavior was simulated by satisfying mass balance equations for conservative and nonconservative substances at nodes and by transporting materials between nodes according to other them. between nodes according to advective and diffusional properties of the system. Examples of model application were given for the San Francisco BayDelta System and two estuaries in Australia. Suggestions were made for future research on estuarial hydrodynamics and water quality and for the application of systems analysis as a tool in water resource management. (Thiuri-Cornell) W69-08537

RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER FLORIDA

State Univ. of New York, Binghamton. Dept. of Geology.

Vladimir Jindrich. J Sediment Petrol, Vol 39, No 2, pp 531-553, June 1969. 23 p, 14 fig, 1 tab, 34 ref.

Descriptors: *Sedimentation, *Limestones, *Tidal waters, *Currents (Water), *Florida, Deltas, Channel morphology, Sedimentary structures, Ripple marks, Diagenesis, Sand waves, Conglomerate Identifiers: Key West (Fla).

Bluefish Channel, north of Key West, Florida, is a prominent ebb channel incised into a thick Recent carbonate bank that overlies Pleistocene limestone. The dominant sediments are Halimeda, foraminifera, molluscs, and fragments derived from the Pleistocene bedrock. Because the source area is the entire course of the channel, sediment mixing results in textural inversions (abnormal size-toroundness relations) and characteristically negatively-skewed channel sands. A plot of sorting vs grain size of sediments of energy-levels reveals a sinusoidal trend similar to that of beach sediments. With increased sorting and abrasion, the constituents tend to be distributed proportionally in the sediment. The best sorted sediment is mature medium calcarenite, a mixture of 4 constituents in almost equal proportions. Some calcarenites deposited at the tidal delta show the initial stages of cementation by chemically precipitated aragonite crystals. Hydrodynamically, the channel is characterized by the upper-flow regime. The most conspicuous bed forms are straight-crested magarip-ples at the channel mouth and adjacent parts of the rapidly growing tidal delta. Here beds of cohesive carbonate muds are exposed to submarine erosion, producing armored mud balls and intraformational flat-pebble conglomerates, identical with some of those interpreted as a product of supratidal environment. (Knapp-USGS)
W69-08577

THE SIGNIFICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND MODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN,

Goldsmiths' Coll., London (England). Dept. of

Goldsmiths Coll., London (England). Dept. of Geology and Geography; and Georgia Univ., Sapelo Island. Marine Inst.
John R. Hails, and John H. Hoyt.
J Sediment Petrol, Vol 39, No 2, pp 559-580, June 1969. 22 p, 10 fig, 5 tab, 22 ref. Grants NSF-GP 1380 and NSF-GA 704.

Descriptors: *Sedimentation, *Particle size, *Statistical methods, Coasts, Estuaries, Tidal marshes, Beaches, Sands, Sand bars, Currents (Water), Waves (Water), Paleohydrology, Deposition (Sediments), Erosion, Sediment transport. Identifiers: Georgia Coastal Plain.

The lower Coastal Plain of Georgia is a significant area for the study of preserved coastline sediments area for the study of preserved coastine securions because ancient deposits are generally well preserved. Samples were collected from 6 Pleistocene barrier coastlines and the Holocene coast to evaluate the statistical parameters for distinguishing ancient and modern sedimentary en-vironments. The sediments of each barrier coast-line can be subdivided into lagoon-salt marsh and barrier-island facies. The lagoon-salt marsh facies includes estuarine and tidal channel sediments, and the barrier facies includes dune, littoral, shallow neritic and offshore channel deposits. Barrier

Group 2L—Estuaries

island sands are better sorted than those from lagoon-salt marsh environments although all samples have mean grain size values higher than 1.50 phi. The coarsest sediments in the barrier island environments are found in the tidal inlets and chan-nels, and about 70% of the samples are negatively skewed. About 30% of the lagoon-salt marsh sands are positively skewed. More than 90% of the Holocene beach sands are negatively skewed, but about 70% of the dune sands show positive skewness. The sign of skewness in this study is related to energy variations in different sedimentary environments. (Knapp-USGS) W69-08578

OBSERVATIONS OF MOTION AT INTER-MEDIATE AND LARGE SCALES IN A COASTAL PLAIN ESTUARY,

Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.

Glenn A. Cannon.

Chesapeake-Bay Inst Tech Rep No 52, Mar 1969. 116 p, 26 fig, 13 tab, 25 ref. Contract No. Nonr 4010 (11) ONR. Proj No NR 083-016 ONR.

Descriptors: *Currents (Water), *Estuaries, Current meters, Streamflow, Velocity, Tides, Seiches, Regression analysis, Turbulence, Water circulation, Waves (Water).
Identifiers: *Chesapeake Bay, Kinetic energy den-

sity spectra, Patuxent estuary.

Observations of motion at intermediate and large scales were made in a coastal plain estuary using current meters consisting of 2 propellers rigidly attached to a bottom mounted tower, oriented at right angles to each other to measure the horizontal velocity vector. At large scales the results indicated that estimates of river flow from observations of current velocity and salinity can be difficult and that bottom friction may have more effect on tidal currents in the estuary than was previously known. Spectra of kinetic-energy density at intermediate frequencies were similar in one run over horizontal distances of 500 m, and they could be satisfactorily represented in 2 frequency bands by straight lines (on log-log plots) with a -5/3 slope. Between the 2 regions with -5/3 slopes, there was an increase in the energy level in both velocity components by a factor of about 2. The natural period for crosschannel seiching occurred in the same interval. Spectra from the other 2 runs showed significant time changes. Estimates of coherence at intermediate frequencies using record lengths of several tidal cycles appeared to be unreliable, and the phases appeared to vary randomly as a function of frequency. (Knapp-USGS) W69-08598

03. WATER SUPPLY **AUGMENTATION** AND CONSERVATION

3A. Saline Water Conversion

DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, Kaiser Engineers, Oakland, Calif. P. D. Bush, J. Finke, and J. R. Wilson.

Environmental Science and Technology, Vol 2, No

6, pp 428-434, June, 1968. 6 p, 4 fig.

Descriptors: *Variable costs, *Desalination plants, *Electric power production, Alternative costs, Annual costs, Capital costs, Unit costs, Economic feasibility, Electric power rates, Initial costs, Maintenance cost, Operating costs. Identifiers: *Desalination-power plant, Israel,

This paper reports on an engineering feasibility and economic study of a dual-purpose power generation and desalinization plant to be located in Israel. The proposed plant (100 m.g.d.) was 40 times larger than any operating at that time. Estimated unit water cost studies were followed by studies of capital cost variants and annual cost variants in an effort to evaluate their effect on unit water cost. These studies show that the variables can only affect unit cost of water from dual-purpose plants by 15%, from best to worst conditions. Also revealed is that the desalting plant design which is optimum for one fixed charge rate may be used for other fixed charge rates with essentially no economic penalty. (Sherbrooke-Ariz) W69-08295

REVERSE OSMOSIS MEMBRANE REGENERA-

American Standard Inc., New Brunswick, N. J. E. A. G. Hamer, and R. L. Kalish. OSW R and D Report No 471, OSW 14-01-0001-1171, 1969. 80 p.

Descriptors: *Desalination, *Reverse osmosis, *Membranes, Regeneration.
Identifiers: *Membrane compaction, Flux restoration. Membrane cleaning.

Laboratory investigations were carried out to determine the feasibility of (1) removing scale from cellulose acetate membranes that had been used for reverse osmosis demineralization, and (2) restoring the performance of compacted membranes by subjecting them to various regeneration treatments. Sodium hydrosulfite solutions and oxalic acid solutions at concentrations of 1-5 percent and 0.2 percent, respectively, were effective in cleaning the membrane without degrading it, but there was little subsequent improvement in membrane performance. On the other hand, membranes that had been subjected to accelerated compaction at 1,500 psi were effectively regenerated by simple soaking in hot water at temperatures approaching the values originally used in their production. Flux recoveries up to 60 percent were achieved with no net loss in salt rejection. (Mintz-Office of Saline Water) W69-08395

MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION,

Houston Research Inst., Inc., Tex C. J. Huang, H. M. Lee, and A. E. Duckler. Int J Sci Technol Water Desalting, Vol 6, No 1, p 25-56, Apr 1, 1969. 32 p, 12 tab, 13 fig, 9 ref.

Descriptors: *Mathematical models, *Dynamic programming, *Simulation analysis, *Optimization, *Desalination, Evaporation, Design, Saline water, Capital, Evaporators, Size. Identifiers: Module approach, Vertical tube

evaporation, Gradient techniques.

The techniques of obtaining optimum design for a desalting plant were presented. The objective of the study was to develop a computer program for simulating and designing a multistage vertical tube evaporation falling film desalination plant, which could be constructed with a minimum capital investment, or which produced fresh water at the lowest cost possible. The 'module approach' was adopted for developing the complete system that was divided into four major subsystems. Dynamic programming was applied to optimize simultaneously tube size distribution and recirculation rate. The gradient searching technique was found to be most suitable for optimizing a continuous process. As an example, the application of the model, an optimum design of a saline water conversion plant with product rate of 50 million gallons fresh water per day was presented. It was demonstrated that for a specified production capacity an optimum design of a desalting plant can be directly and automati-cally generated by the programmed model and that the simulation and optimization system developed was reasonably general, versatile and flexible. (Thiuri-Cornell) W69-08549

3B. Water Yield Improvement

WATER YIELD CHANGES AFTER CONVERT-ING A FORESTED CATCHMENT TO GRASS, Forest Service (USDA), Tempe, Ariz. Forest

Hydrology Lab. A. R. Hibbert.

Water Resources Res, Vol 5, No 3, pp 634-640, June 1969. 7 p, 3 fig, 13 ref.

Descriptors: *Water yield improvement, *Clearcutting, *Evapotranspiration control, Evapotranspiration, Infiltration, Rainfall-runoff relationships, Forest management, Watershed management, Water management (Applied), Water harvesting. Identifiers: Grassed watersheds.

A 22-acre catchment in the southern Appalachians was cleared of hardwood forest in 1958 and 1959 and seeded to Kentucky 31 fescue grass in 1959 and 1960. The amount of evapotranspiration by the grass cover was closely related to the amount of grass produced. During years when grass production was high, water yield from the catchment was about the same as or less than the expected yield from the original forest. As grass productivity declined, water yield gradually increased until it exceeded the predicted yield from the forest by over 5 inches annually. The grass appeared to evaporate more water early in the spring and less water late in the summer than the original forest cover. (Knapp-W69-08200

ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY,

California Univ., Davis. For primary bibliographic entry see Field 02D.

DROUGHTS IN FINNISH WATERCOURSES WITH REFERENCE TO WATER SUPPLY AND POLLUTION CONTROL (FINNISH), Finnish Hydrological Office, Helsinki

For primary bibliographic entry see Field 02E.

A PRACTICAL FIELD TECHNIQUE FOR MEA-SURING RESERVOIR EVAPORATION UTILIZ-ING MASS - TRANSFER THEORY, Geological Survey, Washington, D. C.

For primary bibliographic entry see Field 02D.

INFLUENCE OF GAP WIDTH BELOW A VER-TICAL SLAT SNOW FENCE ON SIZE AND LOCATION OF LEE DRIFT,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02C W69-08450

SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW COVER, Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02C W69-08451

PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULA-

TION PROJECTS,
Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. Ronald D. Tabler

Water Resources Research, 1968, 4 (3): 513-519, Illus.

Descriptors: *Snow management, *Optimum development plans, *Cost-benefit analysis, *Proba-

bility, Economic justification, Project planning, Economic feasibility, Evaluation, Economics, Project benefits, Snowpacks. Identifiers: *Snow fences.

Snow fencing promises to be an important means of increasing surface water yield or ground water recharge on windswept watersheds where snow is an important form of precipitation. Assuming an equally spaced series of snow fences, a physical production function can be developed that relates fence spacing to the 'most probable' annual snow catch, based on a probability analysis of winter precipitation. The optimum scale of development in terms of fence spacing, determined by standard marginal analysis, indicates that the smaller the marginal value of output with respect to inputs, the greater the probability must be of the fences filling annually if net benefits are to be maximized. W69-08459

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-D,

Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02I.

SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN COLORADO, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 021. W69-08468

PRELIMINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE CREEK, ARIZONA WATERSHEDS, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Station.

Lowell R. Rich.

Ariz Watershed Symposium Proc (12) 1968, 9-12,

Descriptors: *Watershed management, *Forest management, *Water yield, Ponderosa pine trees, Weirs, Sampling, Slopes, Clear cutting, Water yield improvement.

Indeptotement: *Even aged forest management, *Systematic sampling, Timber yields, Experimental watersheds, Aspect, Slopes, Litter.

Preliminary measurements indicate increased water yields following timber harvest on West Fork of Castle Creek. Timber harvest treatment included clear cutting one-sixth of the watershed in blocks fitted to overmature and dwarf mistletoe infected tree classes. The remaining five-sixths of the watershed was placed in the best growing condition possible for the existing ponderosa pine stand. W69-08472

THE WORKMAN CREEK EXPERIMENTAL WATERSHED,

WATERSHED,
Forest Service (USDA), Tempe, Ariz. Rocky
Mountain Forest and Range Experiment Station.
Lowell K. Rich, H. G. Reynolds, and J. A. West.
Salt River Valley Water Users Asso, published as USDA Station pap, RM-65 (1961). 18 p.

Descriptors: *Demonstration watersheds, *Humid areas, *Water yield, *Sedimentation, *Regression analysis, Riparian plants, Streamflow, *Water yield improvement

Identifiers: *Moist site timber, Perennial grass, Experimental watersheds.

The Workman Creek experimental watersheds lie within the humid forest type of central Arizona about 50 miles north of Globe, Arizona. Of the three watersheds available, one is reserved as a control to determine treatment effects on the other two. The North Fork watershed is used to evaluate changes in water yield and sedimentation resulting from removing or changing cover types. The first

treatment was a riparian cut to remove broadleaf trees along the stream channel. The second step was a moist site cut to remove and replace with perennial grass all trees growing on moist bottom sites. The riparian cut had no effect on streamflow, the moist cut after two years indicated nonsig-nificance for a year of below average streamflow and significance for a year of above average streamflow. South Fork is being managed for production of high quality timber and its effect on water and sediment yields. The first cut removed about 50% of the merchantable volume and was followed by an improvement cut. This timber harvest cut did not affect water yields. W69-08473

WATER YIELDS RESULTING FROM TREAT-APPLIED TO MIXED CONIFER MENTS WATERSHED,

(USDA), Tempe, Ariz. Rocky Forest Service Mountain Forest and Range Experiment Station. Lowell R. Rich.

Arizona Watershed Symposium Proc (9) 1965, 12-15, illus.

Descriptors: *Water, *Mixed forests, *Regression analysis, Watershed management, *Water yield im-

analysis, watershed management, which yellow provement, Coniferous forests. Identifiers: *Riparian cut, *Moist site forest vegetation, Wildland watersheds, Management practices, Timber harvest, Experimental watersheds, Perennial grasses.

Removal of moist site forest vegetation along main stream channels and replacement with perennial grass have resulted in significant water yield ingrass have resulted in significant water yield increases. The adjusted increase would be 1.1 inches+ 0.3 inch at the 95 percent level: this increase averages 46 percent. A commercial timber harvest on an individual tree selection harvest did not significantly increase water yields. One problem for the future is to find a method of timber harvest that will increase water yields and method of timber harvest that will increase water yields and produce a favorable tree cover for needed uses.

W69-08477

PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. L. R. Rich

Arizona Watershed Sympos Proc (4) 1960, 13-16,

Descriptors: *Demonstration watersheds, *Humid areas, *Streamflow, Sandstones, Loam, Clay loam, areas, "StreamHow, Sandstones, Loant, Clays, Mixed forests, Riparian plants, Precipitation, Sediments, Coniferous forests, Water yield improvment, sediment yield.

Jdentifiers: Quartizite, Diabase, Perennial grasses,

Experimental watersheds.

Two management treatments are reported for the Workman Creek, Arizona watersheds. Elevations vary from 6,590 to 7,724 feet. Precipitation averages about 32 inches and streamflow about 3 1/2 inches. Mixed conifer vegetation dominates the area. A riparian cut (Arizona alder and big tooth maple) that removed 0.6 percent of trees on the 248 acre North Fork Watershed showed no significant increase in water yields. Following replacement of 80 acres of moist site (white and Douglasfir) vegetation with perennial grass, the first two years of measured streamflow indicate one year of nonsignificance and one year of significantly increased water yield. Sediment yields increased during the first two years. This replacement treatment cost \$379.00 per acre for clearing, windowing, slash burning, seeding, and initial suppression of sprouts. W69-08478

WATERSHED TREATMENT EFFECTS ON

EVAPOTRANSPIRATION,
Forest Service (USDA), Fort Collins, Colo. Rocky
Mountain Forest and Range Experiment Station.

For primary bibliographic entry see Field 02D. W69-08481

IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL OF CHAPARRAL,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. C. P. Pase, P. A. Ingebo, E. A. Davis, and C. Y. McCulloch.

Proc Int Union Forestry Res Organ XIV: 463-486.

Descriptors: *Water yield improvement, *Brush control, *Herbicides, *Deer, Chaparral, Wildlife habitats, Watershed management, Erosion, 2, 4, 5-

Identifiers: *Fenuron, *Picloram, Post-fire erosion.

Aerial and hand application of 2,4,5-T for 4 con-Aerial and hand application of 2,4,5-1 for 4 consecutive years held crown cover of chaparral fire sprouts to 12 percent, compared to 56 percent on unsuppressed fire sprouts. Water yield increases on a 38.6 ha. watershed averaged 76 mm. per year for the first 3 years. With high rainfall the fourth year, the increase was 250 mm. Chemical control resulted in higher forb and grass production and resulted in higher forb and grass production and more deer use than on an adjacent untreated watershed. Hand application of fenuron or picloram to 6-year-old fire sprouts on northerly aspects and channel bottoms on a 18.8 ha. watershed reduced crown cover from 51 percent to 12 percent on the treated area. Water yield appears to be increasing, but data insufficient to draw firm conclusions. Shrub control on cool, more moist interpretage agency cover on southerly sites with interspersed escape cover on southerly aspects might favor deer habitat. W69-08483

BURNED CHAPARRAL TO GRASS: EARLY EFFECTS ON WATER AND SEDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN ARIZONA,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. Charles P. Pase, and P. A. Ingebo. Ariz Watershed Symp Proc 9: 8-11, illus. 1965.

Descriptors: *Chaparral, *Brush control, *Water Descriptors: *Cnaparral, *Brush control, *Water yield improvement, Accelerated erosion, Vegetation effects, Watershed management, Shrubs, Herbicides, Burning, Vegetation regrowth, 2-4-55-T. Identifiers: *Post-fire erosion, Live oak, Experimental watersheds.

Annual spraying with 2,4,5-T following a wildfire in chaparral successfully held resprouting brush cover to less than 10 percent crown density and allowed to less than 10 percent crown density and allowed establishment of a good grass cover. Compared to an adjacent watershed returning to brush cover, water yields increased significantly. Sediment yields increased immediately after the fire, and declined to near prefire levels within 5 years. W69-08485

HELICOPTER-APPLIED HERBICIDES CON-HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND BIRCHLEAF MOUNTAINMAHOGANY,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station.

Pase

US Forest Serv Res Note RM-84. 4 p, illus. 1967.

Descriptors: *Brush control, *Herbicides, Chaparral, *2-4-5-T, Shrubs, 2-4-D.
Identifiers: Helicopter, Aerial spray, Live oak, Mountainmahogany.

Four annual helicopter applications of 2,4,5-T to fire sprouts of chaparral held shrub live oak and birchleaf mountainmahogany cover to less than 5 percent, while unsprayed sprouts increased to 21 percent, while unsprayed sprouts increased to 21 percent. No difference was found between emulsifiable and invert forms of 2,4,5-T, and 1:1 mixtures of oil soluble 2,4,5-T and 2,4-D. PBA and TBA were substantially less effective in retarding shrub growth. W69-08486

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3B-Water Yield Improvement

PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID RE-

GION, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. C. J. Campbell, and Win Green. J Ariz Acad Sci Vol 5, No 2, p 86-98, Oct 1968.

Descriptors: *Riparian plants, *Succession, Distribution patterns, Ecology, Cottonwoods, Mesquite, Riparian water loss, Vegetation, Elevation

Identifiers: *Riparian hardwoods, Sycamore.

The community aspects of channel vegetation with respect to changing elevation on Sycamore Creek, Maricopa County, Arizona were studied by means of 402 stratified random, 0.05-acre quadrats to determine shrub and tree composition, and 150 permanently located 9.6-square-foot quadrates to determine grass and forb composition. Ninety-five percent of the shrub species sampled and approximately 50 percent of the tree species are indigenous to the semiarid mountain slopes, and are not dependent upon additional subsurface moisture in the channel for survival. The true riparian species exist only where additional subsurface moisture is available in addition to annual precipitation. Riparian species are found along the stream channel in a relatively narrow band sometimes bisects sharply demarked vegetational zones. The channel vegetation probably never reaches a climax hierarchy due to periodic flood disturbances such as erosion, inundation, and deposition. As a result, mosaics of various seral stages with different dominant species characterize the vegetation communities. W69-08489

WATER TABLE CHARACTERISTICS UNDER

TAMARISK IN ARIZONA,
Forest Service (USDA), Tempe, Ariz. Rocky
Mountain Forest and Range Experiment Station.
Howard L. Gary, and C. J. Campbell.
USDA Forest Serv Research Note RM-58, 7 p, Nov

Descriptors: *Water table, *Tamarisk, *Evapotranspiration, *Water loss, Consumptive use, Transpiration riparian plants, Riparian water

Water-table characteristics under Tamarix pentandra in central Arizona are described. Water-table fluctuations in 39 ground-water wells within a circular area of about 40 feet in diameter are discussed before and after vegetation removal. Pumping tests to simulate natural diurnal fluctuations in selected wells were not satisfactory. ET losses were not determined. W69-08490

GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. J. S. Horton, T. W. Robinson, and H. R. McDonald. For sale by Sub Dec USGPO for 20 cents. U S Dep Agr, Agr Handbook, No 266, May 64. 37 p, illus.

Descriptors: *Vegetation, Surveys, *Aerial photog-*Phreatophytes, *Statistical methods, raphy, Friteatophytes, Statistical Inclinous, Tamarisk, Riparian plants, Playas, Flood plains, Water loss, Riparian water loss, Evapotranspiration, Vegetation effects.

Identifiers: Vegetation surveys.

In the arid and semiarid region of the western United States; water losses from stream channels, flood plains, bottom lands, and delta areas by evapotranspiration are serious. In spite of water losses and creation of additional flood hazards, vegetation growing along streams or on flood plains wegetation growing along streams of or roote plans may have considerable economic value for recrea-tional use, grazing, wildlife, or flood control. To properly manage bottom-land and streambank areas and to evaluate the overall effects of vegetation treatments, surveys are needed to determine

the kinds of plants present in the existing stands, the relative importance of component species, and such characteristics of the vegetation as percentage of the ground covered by living plants, average height and crown thickness of the trees and shrubs, and the amount of understory vegetation. An economic sampling scheme that can be repeated and will yield data precise enough to be reliable is described. W69-08491

OBSERVATIONS OF SNOWPACK ACCUMULATION, MELT, AND RUNOFF ON A SMALL ARIZONA WATERSHED,

Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station. Peter F. Ffolliott, and Edward A. Hansen. USDA Forest Serv Res Note RM-124, 1968. 7 p.

Descriptors: *Snowpacks, *Runoff, *Snowmelt, Streamflow, Overland flow, Elevation, Coniferous forests, *Water field improvement, Ponderosa pine trees, Forest management, *Watershed manage-

Identifiers: *Experimental watersheds.

Intensive measurements of snow and streamflow on a 425-acre ponderosa pine watershed indicated that more than 90 percent of the snowpack left the watershed as runoff. Snow accumulation was inversely related to forest density, which indicates a possible opportunity for increasing snow accumulation through more intensive forest management. W69-08493

OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEMONSTRATION CUTTINGS PINE PONDEROSA IN CENTRAL ARIZONA,

Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station. Edward A. Hansen, and Peter F. Ffolliott. USDA Forest Serv Res Note RM-111, 1968. 12 p.

Descriptors: *Snowmelt, *Snowpacks, Coniferous forests, *Water yield improvement, Timing, Snow cover, Ponderosa pine trees, *Watershed management, Forest management, Clear-cutting, Water

Identifiers: *Experimental watersheds.

A clearcut block on a north aspect and strips with widths of one and one-and-one-half times tree height on an east aspect increased snow accumulation and increased rates of melt and daily water loss. A strip three-fourths as wide as tree height on a west aspect increased snow accumulation. None of the strips cut on south and southwest aspects affected snowpacks measurably. W69-08494

POSSIBILITIES OF INCREASING STREAM-FLOW FROM FOREST AND RANGE WATERSHEDS BY MANIPULATING VEGETATIVE COVER THE PROPERTY. RANGE VEGETATIVE COVER-THE BEAVER CREEK PILOT WATERSHED EVALUATION STUDY, Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. Raymond Price

Inter Union Forest Res Organ XIV. IUFRO-Kongress, VI, Sect 01-02-11, 1967. p. 487-504.

Descriptors: *Water field improvement, *Vegetation effects, *Watershed management, Runoff, Forest management, Coniferous forests, Ponderosa pine trees, Pinyon pine trees, Soil-water-plant relationships.

Identifiers: *Experimental watersheds, Pinyon-ju-

Increasing population, agricultural activity, and industrial development call for increased water supplies in many parts of the world. One possibility of increasing streamflow is through manipulating vegetative cover on watersheds. The Beaver Creek pilot watershed in north-central Arizona has been designed to evaluate possibilities of increasing water yields by modifying vegetative cover. Evalua-tions are made in terms of other multiple-uses and products as well as water and also in economic terms. Studies are underway to lower pinyon juniper woodland, upper pinyon juniper woodland, and ponderosa pine forest types. Precipitation varies from 13 to 25 inches in the lower woodland type, from 14 to 30 inches in the upper woodland type, and from 15 to 43 inches in the pine forest type. Eighteen small watersheds have been delineated and instrumented. Each has been inventoried with respect to soil, timber, forage, and wildlife habitat as well as streamflow. First treatments tested have been drastic measures such as complete removal of trees. Subsequent treatments are less severe. This project involves original work in design, instrumentation, and other methodology. It is closely coordinated with economics research, and economic principles are considered in designing studies and results of treatments can be analyzed in economic terms. (Lloyd-USDA Forest Service) W69-08495

MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Henry W. Anderson

US Forest Service Research Paper PSW-6 (1963):

Descriptors: *Snow management, *Watershed management, *Snowmelt, *Water yield improvement, *Flood control, *Sediment discharge, Forest management, Brush control, Topography, Coniferous forests, California. Identifiers: Forest patterns, Timber harvest,

Logging.

The hydrology of California's snow zone as it affects management for improved water yield is summarized. Broad sources of water yield, variability, and distribution are briefly reviewed. The effects of forests on the processes of snow accumulation and melt and soil moisture are assessed, and the effects of both theoretical evaluations and practical tests are brought together to indicate the effects of forest management alternatives on water yield. Suggested prescriptions for management of forests for water production and control in different forest conditions and sites are outlined. W69-08498

INTEGRATING SNOW ZONE MANAGEMENT

WITH BASIN MANAGEMENT, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Henry W. Anderson.

Water Research (1966): 355-373, The Johns Hopkins Press: Baltimore.

Descriptors: *Snow management, *Watershed management, *Hydrologic budget, *Snowpacks, *Snowdrifts, *Evaluation, Brush, Forest management, Alpine, Mountains, Methodology, Research facilities, Computer models, Colorado, California, Water vield improvement. Water yield improvement.

Identifiers: Hydrologic potential, Forest patterns, Timber harvest, Type conversion.

Snowpacks are managed by controlling snow accumulation, snowmelt, and evaporation; the snowmelt water is further managed by controlling vegetation-induced losses--interception and transpiration--by controlling evaporation from soil and water surfaces, by modifying the retention characteristics of the soil 'reservoir,' and by modifying the surface and subsurface paths that the water takes in its runoff. This paper summarizes some of the present techniques and what they can accomplish, and points out how water management can take its place in basin management. The role of cutting of forest, brushland conversion, and artificial snow barriers in management for water supply and control is illustrated with results from Colorado and California. Tentative criteria are suggested for design of forest cuttings for particular objectives of water yield improvement, flood prevention, and sediment control. Further studies are suggested, both of physical applications to forest sites and of appraisals methods which will allow the integration of physical knowledge in the design of systems of basin management. W69-08503

FORESTS -- USERS OF WATER,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. E. G. Dunford.

Proceedings, Society of American Foresters, 1966:

Descriptors: *Watershed management, *Consumptive use, *Water yield improvement, *Evapotrans-piration, *Interception, Forests, Streamflow, Transpiration, Evaporation, Throughfall, Stemflow, Root zone, Soil moisture, Snow management, Riparian water loss, Forest management, Clear-

cutting.
Identifiers: *Multiple-use management.

The author gives a partial survey and summary of the state of knowledge about uses of water by forests, and points out gaps in knowledge of the complex physical factors involved. Future needs for intensive and intelligent multiple-use management of forested watersheds require that we develop more precise means of measuring the individual sources of moisture use and learn more about how these processes function. W69-08512

3C. Use of Water of Impaired **Ouality**

WATER REUSE IN MONTERREY, MEXICO, Celulosa y Derivados S.A., Monterrey (Mexico). Copropiedad Grupo Quimico. For primary bibliographic entry see Field 05D. W69-08289

WASTEWATER REUSE AT THE GRAND CANYON.

Arizona State Dept. of Health, Phoenix For primary bibliographic entry see Field 05D. W69-08290

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS: IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC WATER POTENTIAL DIFFERENCES BETWEEN ROOT XYLEM AND EXTERNAL MEDIUM, California Univ., Riverside. Dept. of Soils and Plant Nutrition

For primary bibliographic entry see Field 02I. W69-08291

THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS, Zagreb Univ. (Yugoslavia). Geophysical Inst. For primary bibliographic entry see Field 07B. W69-08297

GROUND WATER OF THE WESTERN DESERT

IN IRAQ, Baghdad Univ. (Iraq). Dept. of Geology. Abbas Ihsan Baghdadi. Internat'l Assoc Hydrogeol, Congress of Istanbul, 1967, Memoir 8, pp 525-532, 1968. 8 p, 4 pl, 3 ref.

Descriptors: *Aquifer characteristics, Arid lands, Arid climate, Depression storage, Drainage pat-terns (Geologic), Geomorphology, Playas, Topog-raphy, Valleys, Limestones, Deep wells, Fractures

(Geologic), Geohydrologic units, Groundwater basins, Shallow wells, Springs, Watertable, Saline water, Hardness (Water), Alkalinity, Nitrates, Sulfates, Chlorides, Carbonates. Identifiers: *Western Desert, *Iraq

The little varied topography and dominate geologic features of the Western Desert of Iraq are described under 5 geographical subdivisions; Al Hamad Plain, Upper Wadian, Al Hajara Plain, Lower Wadian and Dibdibba Plain. In the south the watertable is present at a shallow depth, but in the north it is at relatively deep levels. Generally the shallow wells obtain water from valley gravels and sands, while deep wells depend on fractured limestone and porous limestone. Drilled or hand dug wells are located in playas, depressions and val-ley beds. Low rainfall accompanied by high evaporation result in almost no recharge, an important factor in considering exploitation of groundwater resources of this area. The geographic occurrence of 5 types of water are noted; sulphate predominant mixed saline, chloride predominant mixed saline, nitrate, carbonate and alkaline. Water in valley gravels and sands is medium hard, while that in fractured limestone is very hard. yield, chemistry and temperature are noted for springs. (Sherbrooke-Ariz) W69-08298

SEASONAL VARIATION IN ALKALINITY IN PANS IN CENTRAL AFRICA,

Leicester Univ. (England). Dept. of Zoology. I S Weir

Hydro-Biologic, Vol 32, No 1/2, pp 69-80, 1968. 12 p, 8 fig, 11 ref.

Descriptors: *Alkalinity, *Seasonal, Ions, Groundwater, Hydrogenion concentration, Bicarbonates, Hardness (Water), Water analysis, Aeolian soils, Sands, Game management, Dry seasons, Annual,

Wet seasons.
Identifiers: *Pans, *Central Africa, Rhodesia,
Kalahari sand deposits, Wankie National Park.

This paper considers seasonal variation of pH and alkalinity of 65 pans in semi-arid Central Africa. Several types of pans were considered: natural semi-permanent or occasionally permanent, semi-permanent showing human influence, deepened permanent snowing numan influence, deepened permanent, and pumped permanent. pH of natural pans ranged from 6.1 to 8.7 and total alkalinity from 10 mg/l. to 580 mg/l. Variation was attributed to local soil differences. Natural pans reached their maximal size in Jan. or Feb., the rainy season, and showed maximal alkalinity and pH in Aug./Sept. (no rain since April) or in Nov. after the first rains partially filled the pans. Seasonal variation of alkalinity and pH in semi-permanent human influenced and deepened permanent pans followed the pattern of natural pans. 'Pumped' pans were all alkaline with large values of total alkalinity. This was attributed to the nature of the borehole water pumped and period of pumping. There is no correlation between variations in the numbers of game animals recorded at pans with differences in bicar-bonate alkalinity. Fish, turtles or insects living either in permanent or temporary pans have to withstand a wide range of alkalinity fluctuation during the year. (Sherbrooke-Ariz) W69-08301

SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION,

Utah State Univ., Logan. Dept. of Irrigation. For primary bibliographic entry see Field 05D.

3E. Conservation in Industry

W69-08406

THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT,

Geological Survey, Washington, D. C. Water Resources Div.
For primary bibliographic entry see Field 05C.

3F. Conservation in Agriculture

STOMATAL INFILTRATION MEASUREMENTS AS AN INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON,

National and Univ. Inst. of Agriculture, Rehovoth

(Israel). M. Ofir, E. Shmueli, and S. Moreshet. Expl Agric, Vol 4, pp 325-333, 1968. 9 p, 8 fig, 11

Descriptors: *Stomata, *Irrigation efficiency, Infiltration, Moisture availability, Water utilization, Crop response, Epidermis, Irrigation effects, Transpiration, Soil-water-plant relationships, Water conservation, Water requirements, Water utilization efficiency, Cotton, Timing.

Identifiers: Israel.

Experiments with several liquids, leaf positions and times of measurement lead to the development of a single-liquid infiltration method of measuring stomatal opening. Tests showed that use of a 2:1 tur-pentine-parafin oil mixture on the lower surface of the fifth to seventh leaf between 1200 and 1400 hrs. would give a practicle field method of setting cotton irrigation schedules. The infiltration index (determined from stomatal infiltration) was independent of changes in soil moisture conditions above 30-35% available soil moisture, but below this point (range of inflection) the index was very sensitive to soil moisture changes. An irrigation reatment was designed to prevent soil moisture from falling below that of the inflection range. Field test resulted in significantly greater yields from stomata infiltration scheduled irrigation. The practicle applicability of the method is discussed. (Sherbrooke-Ariz) W69-08293

WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY PLANTS, California Univ., Riverside.

Sterling J. Richards. Tran, Amer Soc of Agric Engineers, Vol 11, No 1, pp 74-75, 1968. 2 p, 4 fig, 5 ref.

Descriptors: *Moisture availability, Irrigation practices, Retention, Soil aggregates, Soil classification, Soil horizons, Soil structure, Field capacity, Wilting point, Tensiometers, Water storage, Moisture tention, Sudangrass, Water-plant relationships, Soil mechanics.

Identifiers: *Water-release curves, Resistance block

The volume fraction of soil water released to growing plants is proposed as a soil property for compar-ing soils or evaluating structural changes in a soil. Water release is measured as a function of soil suction, utilizing a tensiometer and a resistance block. A procedure utilizing soil containers and Sudangrass is detailed. Because most field situations present various soil horizons and rooting characteristics of crops soil-water depletion varies with depth, it is recommended that tensiometers or the test was discounted to the consideration of the control of the blocks be used in each recognized soil horizon and separate water release curves be drawn. Total irrigation water depth would be the sum of all the horizons. Examples of water-release curves are given for three soils with widely varing textures. Two soils in spite of wide differences in texture had almost identical water-release curves. Treatment of one soil with an aggregating agent, VAMA, resulted in a marked increase in water release. Water release curves appear to have advantages over other procedures for evaluating the property of a soil to store water for plant use. (Sherbrooke-Ariz) W69-08302

WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS, National Research Centre, Cairo (Egypt). A. A. Abdel Rahman, A. M. El Gamassy, and M. S.

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

Flora Abt B. Morphol Geobot (Jena), Vol 157, No 3, pp 355-378, 1967-68. 24 p, 11 fig, 13 ref.

Descriptors: *Drought resistance, *Irrigation effects, Climatic data, Transpiration, Water balance, Osmotic pressure, Plant physiology, Drought tolerance, Resistivity, Salt tolerance, Root development, Root distribution, Stomata, Turgidity, Arid lands, Water requirements, Xerophytes, Desert plants, Coastal marshes, Dunes.

Identifiers: *Agave Sisalana, United Arab Republic.

Two-year studies on plants growing naturally, plants continuously irrigated and plants irrigated only in summer were completed at two different habitats, inland desert and coastal sand dunes. All agaves planted at a salt marsh died. Hourly, monthly and seasonal changes for transpiration rate, relative turgidity, and osmotic pressure are re-lated to environmental conditions and irrigation treatment. The results demonstrate the extreme drought resistance of this plant. Annual transpiration intensity was an extremely low 43 mg./g./h. Moderate osmotic pressure max. 29.3 atm., was reached under adverse conditions. Uprooted plants afforded a saturation deficit of up to 50% in three months, without losing their vitality. Succulence provided agaves with resistance to long dry rainless periods. Roots remained in the upper 50 cms. of soil under all treatments, deeper water being unavailable to them. Plants under irrigation exhibited longer active growth periods and were more vigorous. (Sherbrooke-Ariz) W69-08303

NET LOSSES IN SPRINKLER IRRIGATION, Technion - Israel Inst. of Tech., Haifa.

Ido Seginer. Agr Meteorol (Amsterdam), Vol 4, No 4, pp 281-291, July, 1967. 11 p, 5 fig, 5 tab, 7 ref.

Descriptors: *Sprinkler irrigation, *Water loss, Deserts, Crop yield, Evaporation, Evapotranspiration, Soil moisture, Water utilization efficiency, Irrigation efficiency, Application methods, Timing. Identifiers: *Net water losses, Israel.

This study estimated the difference between gross water losses and net water losses under sprinkler irrigation of corn in Israel in an attempt to evaluate the significance of published gross water loss data. Net losses were defined as the difference between the consumptive use of water of the sprinkle irrigated crop and the normal evapotranspiration of the unsprayed crop. Irrigation intervals of 3 days and 2 weeks were used with each method. Water quantities were equal. Soil moisture and dry weight yield were determined. No significant differences were exhibited between treatments, except the overhead sprinkling-3 day intermal treatment. This consumed 10% more water than the others (significant at 0.1 level). Gross spray losses of 30% have been cited in the literature for desert areas. More realistic values for large fields under normal agricultural practices and arid conditions would be 15-20%. However, net losses are not expected to rise at a similar rate, as increased gross losses replace increased evapotranspiration during irrigation, thus maintaining a relatively low level of net losses. (Sherbrooke-Ariz) W69-08305

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL

APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources. For primary bibliographic entry see Field 05D. W69-08377

EVAPOTRANSPIRATION RV IRRIGATED CORN,

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Auburn.

For primary bibliographic entry see Field 02D. W69-08428

EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON.

Agricultural Research Service, Thorsby, Ala. Soil and Water Conservation Research Div.; and Alabama Agricultural Experiment Station, Au-

For primary bibliographic entry see Field 02D. W69-08430

WARM-WATER IRRIGATION: AN ANSWER TO THERMAL POLLUTION,

Eugene Water and Electric Board, Oreg. For primary bibliographic entry see Field 05C. W69-08561

EFFECTS OF HURRICANE STORMS ON AGRICULTURE,

Colorado State Univ., Fort Collins. For primary bibliographic entry see Field 02B. W69-08568

MUNICIPAL SEWAGE EFFLUENT FOR IR-RIGATION.

Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05D.
W69-08615

SOIL RESPONSE TO SEWAGE EFFLUENT IR-RIGATION,

Robert S. Kerr Water Research Center, Ada, Okla. For primary bibliographic entry see Field 05D.

CROP RESPONSE TO SEWAGE EFFLUENT, Pennsylvania State Univ., University Park. Dept. of For primary bibliographic entry see Field 05D. W69-08617

PRACTICAL IRRIGATION WITH SEWAGE EF-FLUENT,

For primary bibliographic entry see Field 05D. W69-08619

THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS,

California Univ., Davis, Dept. of Civil Engineering. For primary bibliographic entry see Field 05D.

A TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION,

Soil Conservation Service, Searcy, Ark.; and Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05D.
W69-08623

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD CONTROL AND SOIL CONSERVA-TION.

NY County Law sec 223 (McKinney 1950), as amended, (Supp 1968).

Descriptors: *New York, *Flood control, *Soil conservation, Administrative decisions, Administrative agencies, Local governments, Projects, Legislation, Legal aspects, Flood protection, Ero-Projects, sion, Costs, Eminent domain, Compensation, Easements, Right-of-way, Project planning, Project pur-

Each board of supervisors shall have power to appropriate and expend county funds for the protection of property within the county from floods and for the conservation of soil from erosion. Any resolution in this regard adopted by a board shall include: (a) a statement of purpose and area of the county involved, (b) the name of any waterway to be improved, (c) the nature of the improvement, (d) whether necessary easements, or other necessary rights have been obtained and any compensation agreed to be paid, (e) whether it is necessary to acquire any easements or right-of-way, (f) the esti-mated cost of such improvement, (g) whether ex-penditures are to be financed under the local finance law, (h) whether work will be done by county employees, (i) what portions of the improvements are to be maintained by the county and, (j) reference to a survey or plans of such improvement. Within 10 days after adoption of such resolution, notice of a public hearing thereon shall be given. After the hearing the board of supervisors may adopt a final resolution providing for the vari-ous details necessary to commence the project. (Carruthers-Fla) W69-08130

PATUXENT RIVER WATERSHED.

For primary bibliographic entry see Field 06E. W69-08147

PATUXENT RIVER WATERSHED. For primary bibliographic entry see Field 06E. W69-08148

WATERSHED PROTECTION AND FLOOD PREVENTION.

Vt Stat Ann tit 10, secs 631-636 (1958), as amended, (Supp 1968), 637-641 (Supp 1968).

Descriptors: *Vermont, *Flood control, *Drainage, *Flood protection, Channel improvement, Dams, Dikes, Diversion, Federal government, State governments, Local governments, Legislation, Erosion control, Flood-proofing, Flow control, Multiple-purpose projects, Water policy, Water law, Flood routing, Floods, Streams, Banks, Stream flow, Administrative agencies, Cities, Eminent domain.

The governor may employ any means to avert flood damage. The soil conservation districts are empowered to act under Public Law 566 to carry out programs of flood control, streambank protection, channel improvement and land drainage. A municipality may acquire land for the purpose of constructing improvements for flood prevention under federal law. The Water Conservation Board is empowered to enter into contracts for the construction of dams, structures for streamback protection and channel improvement. The board may pay up 100 percent of the non-federal costs under Public Law 566 for flood prevention, recreation and storage for streamflow augmentation. The board may petition the county court of any county to determine whether necessity requires the state to acquire land within the county for flood control projects. Necessity will be determined by the adequacy of other locations, the nature of the land, convenience to the land owner and the effect on recreation, wildlife, municipal revenue and timber. The board shall pay just compensation for the land taken and may enter the land for inspections and surveys. (Helwig-Fla) W69-08150

DRAINAGE DISTRICTS UNDER 1911 ACT. SC Code Ann secs 18-231 thru 18-246 (1962). Descriptors: *South Carolina, *Drainage districts, *Administrative agencies, *Surveys, Legislation, Legal aspects, Water policy, Jurisdiction, Financing, Drainage, Civil engineering, Data collections, Mapping, Damages, Costs, Investigations, Judicial decisions, Assessments, Evaluation, Value, Propervalues, Public benefits, Watercourses (Legal), Railroads

After a drainage district is established, a complete survey of the drainage district shall be made by the engineer and viewers. The survey shall include the line of each ditch, drain or levee, the location of each main drain and its laterals, and the course and distance of each ditch, as well as, all other appropriate marks and measurements relevant to the drainage district. From this information a map shall be compiled. The engineers and viewers shall classify the land according to the benefit it will receive from the construction of levees, ditches, and watercourses. Land shall be assessed according to this classification. The viewers shall confer with railroad company officials when any watercourses must cross a railroad easement. In the event the conferees cannot agree, the viewers may designate the place and manner of crossing and fix damages. The engineers and viewers must make final reports and notices of same on all actions taken by them and such reports must be filed with the clerk of the court. These reports are subject to review and appeal on motion of landowners affected thereby (Johnson-Fla) W69-08152

CAPITAL CANDY CO INC V CITY OF MONT-PELIER (FLOOD DAMAGE FROM DRAINAGE

For primary bibliographic entry see Field 06E. W69-08176

MUNICIPAL PUBLIC WORKS SC Code Ann secs 59-151, 59-152 (1962).

Descriptors: *South Carolina, *Pipelines, *Navigable waters, *Highways, Cities, Water supply, Pipes, Navigation, Drainage, Legal aspects, Legislation, Water distribution (Applied), Water works, Streambeds, Competing uses, Beds under water, Sewers, Drainage systems, Utilities. Identifiers: *Nontidal waters.

Any city or person may lay pipes for water supply to a community on or under any nontidal navigable stream and, with county approval, on or under any county highway. The pipes cannot interfere with navigation of the stream or free use of the highway. Anyone laying such pipes must keep them in repair. Interference with any public waterworks, sewerage, or drainage constitutes a misdemeanor. (Breeze-W69-08178

PUBLIC WORKS AUTHORIZED UNDER ARTI-

SC Code Ann sec 59-365 (1962).

Descriptors: *South Carolina, *Cities, *Utilities, Descriptors: "South Carolina, Crites, Odintes, *Legislation, Water works, Water supply, Sewers, Piers, Docks, Drainage systems, Legal aspects, Public benefits, Public health, Recreation, Public utilities, City planning, Municipal wastes, Water resources development, Parks, Recreation facili-

Any South Carolina municipality may purchase or construct the following public works: waterworks system, water supply system, sewer system, piers, docks, drainage system, and public recreation parks. (Breeze-Fla) W69-08179

WATER RESOURCE CON-MISSISSIPPI FERENCE - 1969. Mississippi State Univ., State College. Water

Resources Research Inst. For primary bibliographic entry see Field 02E. W69-08221

FLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPER, WYOMING-VOLUME 1. Corps of Engineers, Omaha, Nebr

Prepared for the city of Casper. Corps Eng Flood Plain Rep, Feb 1969. 18 p, 2 photo, 3 plate, 2 tab.

Descriptors: *Floods, *Flood damage, *Wyoming, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Casper (Wyo), Standard project flood, Intermediate regional flood.

Flooding of Garden Creek, Casper, Wyoming is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W69-08224

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN GEORGIA

Corps of Engineers, Atlanta, Ga. South Atlantic

Corps Eng Water Resources Develop Rep, Jan 1969. 59 p, 4 fig, 47 photo, 1 map, index.

Descriptors: *Water management (Applied), *Georgia, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams,

River training.

Identifiers: U.S. Army Corps of Engineers projects

U.S. Army Corps of Engineers water resources development projects in Georgia are listed. The role of the Corps of Engineers in planning and building water resources improvements described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS) W69-08225

FLOOD PLAIN INFORMATION OF NORTH FORK OBION RIVER, HOOSIER AND GROVE CREEKS, UNION CITY, TENNESSEE. Corps of Engineers Memphis, Tenn.

Corps of Eng Flood Plain Rep, Nov 1968. 63 p, 9 fig, 21 plate, 16 tab.

Descriptors: *Floods, *Flood damage, *Tennessee, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood. Identifiers: Union City (Tenn), Standard project flood, Intermediate regional flood.

Flooding of the North Fork Obion River, Hoosier Creek, and Grove Creek, Union City, Tennessee, is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W69-08247

MICHALKA V GREAT NORTHERN PAPER COMPANY (FLOOD DAMAGE).

116 A2d 139-144 (Me 1955)

Descriptors: *Maine, *Flood damage, *Ice jams, Dams, Flooding, Flood control, Floodgates, Floodwater, Ice breakup, Riparian land, Riparian rights, Natural flow doctrine, Alteration of flow, Obstruction to flow, Legal aspects, Water law. Identifiers: Lower riparian owner.

In the trial court, the lower riparian owner had a jury verdict in an action against a dam owner for damage due to flooding. The defendant dam owner excepted to the findings of the jury and the Supreme Judicial Court of Maine sustained those exceptions. The court held that the evidence did not sustain a proximately causal connection between the dam owner's release of water at the dam and the flooding, but instead compelled a finding that the efficient cause of the flooding was the formation of an ice jam below the property of the lower riparian owner. In so holding the court observed that a dam owner could lawfully permit water to pass over its dam in such quantities as water was flowing into the lake above the dam. (Carruthers-Fla) W69-08318

CONSTRUCTION AND REPAIR OF BRIDGES AND DRAINAGE SYSTEMS.

Minn Stat Ann, secs 106.271, 106.471 (1947).

Descriptors: *Minnesota, *Bridges, *Drainage systems, *Local governments, Engineering structures, Abutments, Bridge construction, Civil engineering, Culverts, Bridge design, Repairing, Ditches, Taxes, Assessments, Legal aspects, Benefits, Legislation, Financing, Costs.

This statute provides for the construction, maintenance and repair of bridges and culverts on roads or rights of way. The method of financing such structures is defined and the method of assessing costs set out. Upon completion of any private bridge or culvert on any ditch system it shall be maintained and repaired by the county. Any drainage system shall be inspected annually and repaired as necessary in accordance with existing regulations. Interested or affected persons may petition the proper authorities for repair of any drainage system. There shall be an inspection, hearing and a report before repairs shall be made to any system. The procedure for determining and levying a benefit assessment arising from the construction of any drainage system is explained. (Helwig-Fla) W69-08320

GAINESVILLE STONE CO V PARKER (DAMAGE TO LAND BY FLOODING CAUSED BY IMPROPER DAM MAINTENANCE). 165 SE2d 296-300 (Ga 1968).

Descriptors: *Georgia, *Dams, *Flood damage, *Streams, Legal aspects, Judicial decisions, Floods, Spillways, Dam failure, Dam construction, Damages, Impoundments, Overflow, Water levels, Damages, Impoundments, Overriow, Water levels, Impounded waters, Rock excavation, Quarries, Residual soils, Silts, Livestock, Soils, Remedies, Farms, Adjudication procedure, Maintenance. Identifiers: Evidence, Injunction (Mandatory).

Plaintiffs were landowners adjoining land on which the defendants operated a stone quarry and crushing business. Defendants had constructed a dam for impounding water from a stream which ran through plaintiffs' land. The plaintiffs brought this action seeking damages and injunctive relief, alleging that the defendants had raised the height of the dam and spillway which caused the water to flood plaintiffs' property and render it useless. A jury returned a verdict for the plaintiffs. The court dismissed a procedural claim by the plaintiffs which would render the case unappealable and held that the appeal could be taken. The court held a witness ex-

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

perienced in building dams was competent to testify to the flooding which will occur if a spillway is stopped up. The court further held that a witness was competent to testify to the value of the land if, although not an expert on land value in the area, he is at least familiar with such values. The court held that all testimony given as to the value of the land was admissible and that the lower court was correct in denying the defendants' motion for a new trial. (Shevin-Fla) W69-08323

PARISH OF EAST BATON ROUGE V BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION).

220 S0 2d 767-769 (La Ct app 1969).

Descriptors: *Louisiana, *Drainage, *Canals, *Eminent domain, Legal aspects, Judicial decisions, Condemnation, Drainage engineering, Ditches, Surface waters, Public benefits, Compensation, Condemnation value, Damages, Natural streams, Construction, Flow augmentation. Identifiers: Natural drainage.

The Parish of East Baton Rouge, as plaintiffs, sought to appropriate a strip of defendant's property for the construction of a drainage canal. The defendant challenged the compensation offered to him. The lot was originally crossed by a natural drain that filled during rainfall. The Parish had previously dug out this natural drain to allow the water to flow away so that at the time of this suit, the lot was crossed near its center by a small, meandering ditch. The trial court had accepted the testimony of the plaintiffs' expert witness as to the value of the land and held the compensation of \$1,685 to be proper. The appellate court held that since the testimony of the plaintiffs' expert on land values had not been rebutted the trial court's determination would be upheld. The court rejected the defendant's contention that the canal construction would damage his remaining property and refused to allow him any further compensation based on this claim. The court held that the trial court's determination constituted a just and adequate compensation for the land taken and affirmed the decision of the lower court. (Shevin-Fla) W69-08324

CONSERVATION OF WATER.

Md Ann Code Art 25, sec 168 (1957), as amended, (Supp 1968).

Descriptors: *Maryland, *Water conservation, *Water utilization, Administrative agencies, Administrative decisions, Legislation, Legal aspects, Regulation, Cities, Municipal water, Water supply, Water shortage, Local governments, Water allocation (Policy), Water distribution (Applied), Water requirements.

Identifiers: Raw water, Water engineer.

Whenever a request to restrict the use of water furnished by the mayor and city council of Baltimore in certain counties is made by the water engineer, then the county commissioners of certain counties are authorized to restrict the use of such water to any person or property located in such counties: (1) to the same extent as restrictions are imposed on water consumers in the city of Baltimore when restrictions are required by a water shortage, or (2) over or within limited areas when required because of water distribution system deficiencies. Before restrictions are imposed in any limited area in any of certain counties, the water engineer shall determine that the unrestricted use water in all other areas of any of said counties will have no detrimental effect on the area to be restricted. The county commissioners of said counties have the power to pass any and all ordinances or regulations necessary for the imposition of such restrictions and to provide penalties for their violation. (Carruthers-Fla) W69-08334

CREEKS OR RUNS; WIDENING, STRAIGHTENING, ETC.

Del Code Ann tit 9, sec 1526 (Supp 1966).

Descriptors: *Delaware, *Streams, *Alteration of flow, *Flow augmentation, Local governments, Legislation, Condemnation, Condemnation value, Land use, Public benefits, Riparian owners, Diversion, Surveys, Eminent domain, Administrative agencies, Stream improvement. Identifiers: Land purchase, Public dedication.

When the County Council of New Castle County, upon the advice of the Department of Public Works, deems it advisable to widen or straighten any creek in the county, the Council and Department may enter the land for the purpose of surveying and locating necessary changes. Owners of land which must be taken to alter the creek may dedicate the land or the County Council may purchase it upon such terms as it deems advisable. If the owner and Council cannot agree on terms, the Council may acquire the land by condemnation. (Kahle-Fla) W69-08337

CONSTRUCTION OF IMPROVEMENT.

SC Code Ann secs 18-271 thru 18-284 (1962).

Descriptors: *South Carolina, *Drainage, *Construction, *Administrative agencies, Drainage districts, Contracts, Construction costs, Bridges, Lands, Right-of-way, Land clearing, Lumber, Outlets, Condemnation, Condemnation value, Adjudication procedure, Ditches, Drains, Watercourses (Legal), Highways, Assessments, Laterals, Engineering structures, Drainage systems, Levees, Legislation, Railroads.

Identifiers: Notice, Improvements, Competitive bidding, Fences.

Whenever an improvement is to be made in a drainage system, the drainage commission must give two weeks notice before making such improvement. There shall be competitive bidding before such improvement is contracted. The contractor may enter any lands necessary for the construction and removal of any bridge, fence or timber that will hinder the work. A right-of-way through lands not affected by the drainage system may be obtained by condemnation. Whenever the drain crosses a highway, all costs of replacing said highway shall be paid by the county. If the highway is beneficially affected, the county shall be assessed for the improvement. The commission may obtain rights-of-way over railroad crossings but the work shall be done in such a manner as to cause the least interference with the operation o of the railroad. The owner of land who has been assessed for the construction of a drainage ditch has a right to use said ditch as an outlet for lateral drains from his land. The commission may join with the proper officials of the adjoining counties of any other state in the construction or improvement of any drainage system. (Shevin-Fla) W69-08339

PROCEDURE TO ESTABLISH DISTRICTS.

SC Code Ann secs 18-211 thru 18-224 (1962).

Descriptors: *South Carolina, *Drainage districts, *Adjudication procedure, *Public benefits, Levees, Drains, Canals, Ditches, Watercourses (Legal), Construction, Land reclamation, Swamps, Wetlands, Overflow, Public health, Tile drainage, Costs, Right-of-way, Land tenure, Assessments, Administrative agencies, Surveys, Publications, Legislation, Highways. Identifiers: Drainage improvements, Tide gates, Notice, Public highways, Counties, Engineer.

The clerk of the court of common pleas of any county may establish a drainage district in his county. A majority of the landowners in an area may file a petition requesting a drainage district and post

bond. The clerk shall then serve a summons on all landowners who have not joined in the petition. The summons may be served by publication. The clerk shall then appoint an engineer and two resident freeholders to examine the land and file a report on the practicability of the proposed district and any benefits which might inure from it. If the report is unfavorable the petition shall be dismissed. If the report is favorable the clerk shall set a day for a hearing. Notice of the hearing must be published. At the hearing it shall be determined if each landowner in the proposed district will benefit. Any landowner who will not benefit shall be withdrawn from the district. At the hearing, those present shall discuss the sufficiency of the district and the need for any changes. If the clerk is satisfied by the proceedings, he may declare the district established. Any person aggrieved by the decision may appeal to the court of common pleas for the county. (Shevin-Fla) W69-08340

EXCAVATING AND DREDGING IN PUBLIC WATERS.

NH Rev Stat Ann secs 488-A:1 thru 488-A:5 (1968).

Descriptors: *New Hampshire, *Excavation, *Dredging, *Permits, Legislation, Water levels, State governments, High water mark, Administrative agencies, Relative rights, Riparian rights, Legal aspects, Adjudication procedure, Regulation, Public rights, Swamps, Marshes, Wetlands, Land reclamation, Restoration, Land tenure. Identifiers: *Public waters, *Water resources board, Natural ponds.

Any owner of a shore line on public waters desiring to dredge land below the natural mean high water level of the public water must obtain authorization. The water resources board handles all petitions for this authorization. After proper notice and a public hearing, the board recommends action to the governor and council. The governor and council may then grant the right for just consideration. Violaters are subject to a maximum \$1,000 fine and may be compelled to return the land to its original condition. (Breeze-Fla) W69-08342

TIDAL WATERS.

NH Rev Stat Ann secs 483:A-1 thru 483-A:5 (1968)

Descriptors: *New Hampshire, *Port authorities, *Dredging, *Excavation, *Tidal waters, Marshes, Shellfish, Wildlife conservation, Fisheries, Runoff, Administration, Administrative agencies, Bank stability, Swamps. Identifiers: Violations, Fines.

Prior to any proposed excavating, filling or dredging of any bank, flat, marsh or swamp in and adjacent to tidal waters, written notice accompanied by a detailed plan of such proposal must be submitted to the New Hampshire Port Authority. Said authority shall hold a public hearing on said proposal after notifying the person intending to do the work, the water supply and pollution control commission and the New Hampshire fish and game department of the time and place of said hearing. The port authority may deny the petition or require additional installations to prevent subsequent fill runoff back into tidal waters. If the proposed area contains shellfish or other fisheries and wildlife, conditions or measures may be imposed by said authority to protect such resources. Any party to the action or proceedings of the port authority may apply for a rehearing. Violators of this chapter shall be liable for abatement of any structures placed in violation hereof and subject to a one thousand dol-lar fine. (Holt-Fla) W69-08343 DAMS AND FLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE WATER RESOURCES BOARD).

NH Rev Stat Ann secs 482:60 thru 482:73 (1968).

Descriptors: *New Hampshire, *Administration, *Decision making, Legislation, Adjudication procedure, Costs, Investigations, Dams, Legal aspects, Judicial decisions, Water resources development, Management, Administrative agencies, Regulation.

Identifiers: *Hearings, *Penalty, *Appeals.

Administration, procedure, and appeals of the New Hampshire Water Resources Board are provided. The Board exercises a judicial function in making decisions under regulations and rules of the Water Resources Board. The qualifications, temporary appointments and compensation for board members are provided. The Water Resources Board is authorized to expend funds granted it by the legislature for performing its duties. A majority of the Board shall constitute a quorum to transact business. On certain occasions, investigations may be held by one or more members. The Board is empowered to subpoena and examine dam owners and their records or any other person. Failure to appear or failure to observe the rules and regulations of the Water Resources Board is a punishable offense. (Gadd-Fla) W69-08345

PLACING FILL IN PUBLIC WATERS.

NH Rev Stat Ann secs 482:41-e thru 482:41-i (1968).

Descriptors: *New Hampshire, *Landfills, *Land forming, *Public rights, Administrative agencies, Legislation, Water law, Water policy, Legal aspects, Jurisdiction, Permits, Regulation, Governments, State governments, Local governments, Federal government, Riparian rights, Flow, Flow control, High water mark, Piers, Water levels. Identifiers: Public water, Penalties (Civil), Penalties (Civil), Wharves.

No person may fill below the mean high water level of any public waters, defined as all natural ponds exceeding ten acres, with the effect of forming filled land along the edges of such water bodies Public owned water bodies, ie those whose artificial high water level is maintained by the state's exercise of its flowage rights, are similarly restricted. Upon proper notification of the water resources board, the federal, state, or municipal governments are not restricted by this section and may fill beyond the high water mark of such water bodies. The board also reviews plans for construction of all commercial piers and wharves. Subject to a lengthy administrative procedure which includes approval at a public hearing held by the water supply and pollution commission, the fish and game commission, the division of public health, the governor and council may grant a petition asking the right to fill public waters. The water resources board acting alone may grant permission to fill below the artificially created high water level of a publicly owned water body. Persons illegally placing fill are subject to fine and may be compelled to remove same by the superior court. (Johnson-Fla) W69-08346

ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND NAVIGATION.

NH Rev Stat Ann secs 122:1 thru 122:8 (1964), as amended (Supp 1967).

Descriptors: *New Hampshire, *Reservoirs, *Navigation, *Flood control, State jurisdiction, Federal government, Land use, Land management, Rivers, Legislation, Taxes, Water resources development, Condemnation, Jurisdiction. Identifiers: *Land acquisition, Federal constitution, Connecticut River, Merrimack River.

Consent is given, in accordance with the federal constitution, to the acquisition by the United States by purchase or condemnation, of state lands for use in connection with: (a) Bethlehem Junction Reservoir on the Ammonoosuc River; (b) Surry Mountain Reservoir on the Ashuelot River; (c) Blackwater Reservoir on the Blackwater River; and (d) Franklin Falls Reservoir on the Pemigewasset River; authorized by Congress for the benefit of navigation and control of flood waters in the Connecticut and Merrimack rivers. The state shall retain concurrent jurisdiction for purposes of civil and criminal processes and jurisdiction shall revert to the state when such lands shall cease to be the property of the United States. Consent is also given to the acquisition of land for additional projects authorized by the governor and council upon recommendation of the water resources board. Provisions are made for payment by the state to cities and towns of sums representing taxes lost by federal acquisition of the land. (Kahle-Fla) W69-08352

FLOWAGE.

NH Rev Stat Ann secs 482:16 thru 482:22 (1968).

Descriptors: *New Hampshire, *Dams, *Water policy, *Administrative agencies, Regulation, Legislation, Water law, Legal aspects, Dam construction, River regulation, Flood control, Flow, Flow control, Water levels, Riparian rights, Water conservation, Water management (Applied), Water utilization.

Upon obtaining authorization, a landowner or another with the owner's consent may erect and maintain a dam across any stream or may increase the height of any dam (by flashboards or permanent construction) for the purposes of working any mill on such stream, creating a reservoir of water or raising the level of a public lake, or conservation or equalization of the flow of such stream. The rights of others operating dams and a town's rights over highways and bridges may not be adversely affected thereby. An owner of a dam must petition the water resources board for a hearing before he is allowed to erect a dam or increase the height of an existing one. The board investigates such things as necessity of timber clearing, increased hazards to navigation, and effect on wildlife before issuing its order. This order shall incorporate all its findings. (Johnson-Fla)

DAMS AND FLOWAGE: PROCEEDINGS IN COURT.

NH Rev Stat Ann secs 482:23 thru 482:34 (1968).

Descriptors: *New Hampshire, *Dam failure, *Damages, *Judicial decisions, Administrative agencies, Legislation, Legal aspects, Water law, Water policy, Riparian rights, Dam construction, Dam design, Flow control, Flood control, Remedies, Damsites, Water control, River regulation, Water conservation, Land use, Water resources.

When land is overflowed, drained, or otherwise damaged by use of any dam, the person erecting or maintaining such dam is liable for the damage caused thereby. Settlement may be out of court or in the superior court of the county where such damage took place. Unless the parties agree to provisions of the petition which must state the location of the dam, extent of damages, and be filed with the court, a committee of three disinterested persons is appointed by the forum to determine the truthfulness of matters alleged in the petition. A jury trial as to the extent of damages may be had prior to reference of such petition to the committee. Any person wishing to build a new dam or increase permanently or by flashboards the size of an existing dam must petition the superior court for permission. Such person may be required to post security for damages which may arise from such action. The governor and council can approve the flooding of public lands contiguous to a damsite when the public interest is served thereby. (Johnson-Fla) W69-08357

REGULATION OF WATER RESOURCES. Del Code Ann Tit 7, Secs 6101-6105 (Supp 1966).

Descriptors: *Delaware, *Water resources, *Water management, *Delaware River Basin Commission, Water use, Surface waters, Ground water, Water supply, Watercourses (Legal), Administrative agencies, Ponds, Dams, Reservoirs, Lakes, Rivers, Agricultural watersheds, Domestic Water, Legislation, Legal aspects, Water law, Compacts, Administrative regulations, Planning, Water resources development, Delaware river, Equitable apportionment.

Water resources are to be regulated to assure their optimum beneficial use. Definitions of 'domestic and agricultural use', 'established minimum flow', 'municipal use', 'surface water'. 'underground water', 'water facilities', and 'water-course' are defined for purposes of this statute. The provisions of this chapter shall not apply to (1) water use for domestic and agricultural purposes unless contributing to a water emergency; (2) a landowner's right to dam a stream originating on his property; (3) the right to build a dam or pond and divert water on any stream with a certain minimum daily flow; (4) ponds not larger than 60,000 square feet used for conservation and/or recreation. The commission shall: (1) adopt master water plans for development and use of water resources; (2) advise the Delaware River Basin Commission; (3) study and investigate matters connected with water use; (4) approve the use of water on the basis of equitable apportionment; (5) approve new plans for water facilities; (6) require reports from all Delaware water users regarding water facilities and water use and; (7) reasonable rules and regulations which conform to those of the Delaware River Basin Compact, where applicable. After July 1, 1966 approval of the Commission is needed for any increase in the amount of water used. (Carruthers-Fla) W69-08360

DAMS IN DISREPAIR AND CHANNEL IMPROVEMENT.

NH Rev Stat Ann secs 482:35-482:41 (1968).

Descriptors: *New Hampshire, *Administrative agencies, *Water policy, *Dams, Water law, Legislation, Legal aspects, Political aspects, Dam construction, River regulation, Flood control, Local governments, Regulation, Flow, Flow control, Water levels, Financing, Contracts, Leases, Procurement, Water conservation, Water management (Applied), Water resources, Water utilization, Condemnation, Dam construction. Identifiers: Dam repair, Bonds, Notes.

It is state public policy to repair and construct dams, clear streams, and improve channels for the regulation of water levels, water flow, lessening of flood damage, fire prevention and control and other matters related to conservation and control of state water resources. To carry out these policies the water resources board may acquire, lease, and condemn such property as is necessary to repair or construct dams and it may enter into agreements with private individuals and corporations in furtherance of such policy. The council on resources and development constitutes an advisory board which consults with the water resources board when the latter plans initiation of facilities under this chapter. Upon approval by the resources board, proposals are submitted to the governor and council who must approve such facilities before actual work may be undertaken upon them. Municipalities may finance their share of such facilities by issuance of serial notes or bonds as they may be required in an agreement reached between the state and the local government. (Johnson-Fla) W69-08361

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

INTERFERENCE WITH NAVIGATION, ETC.

SC Code Ann secs 54-401 through 54-405 (1962).

Descriptors: *South Carolina, *Federal government, *Navigation, *Buoys, Ships, Boats, Boating regulations, Regulation, Navigable waters, Legislation, State governments, Damages, Structures, Lighthouses, Anchors, Repairing. Identifiers: *Navigation aids, Penalties, Liens.

Mooring to, removing, damaging, or accidentally injuring without giving notice to the lighthouse engineer, any buoy, beacon or daymark placed in state waters by the United States lighthouse board is punishable by fine or imprisonment. It is unlawful to anchor on the range-line of any range of lights unless such anchorage is unavoidable. The master of any vessel so anchoring shall be punished by fine not to exceed \$50. Failure to keep clear of a marker, or unavoidably fouling it without exercising due diligence in clearing it to prevent dragging the marker from its position is punishable by fine not to exceed \$50. The cost of repairing any marker shall be a lien against the vessel causing damage thereto. Any person willfully damaging, or counseling another to so damage, any structure used under the federal 'Act to Provide for Surveying the Coast of the United States' shall be punished by imprisonment not less than one month and/or fine not exceeding \$50 and shall be liable for expenses of repairing the structure. (Kahle-Fla)

PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO, Wisconsin Univ., Milwaukee.

For primary bibliographic entry see Field 07B. W69-08396

FOREST SITE AMELIORATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,

Mississippi State Univ., State College. School of Forest Resources. W. Frank Miller.

Completion Report, Mississippi Water Resources Research Institute, July, 1969. 17 p, 4 tab, 9 fig, 18 ref. OWRR Project A-013-MISS.

Descriptors: *Drainage, Forest soils, *Growth response, Drainage effects, *Forest management.

Increasing interest is being evidenced in the management of wetland forest sites in both the Atlantic and Gulf Coastal Plains. It is estimated that there exists over 20 million acres of these wetland sites which are not achieving their maximum potential for wood production. The results of this investigation indicate that for the particular physical soil situation examined, drainage of these lands will appreciably increase growth rates. The major effect of ditching was to provide for a more rapid removal of surface water which would normally be ponded for extensive periods. Growth response of slash pine at the end of the second growing season indicated that although there was no statistical difference between seedlings on plots with 2 1/2 chain or 5 chain lateral ditch spacing, seedling growth was significantly better on drained areas when compared with undrained areas. Loblolly pine did not respond to treatment. Growth projections for slash pine based on seedling growth, stem analysis of an older plantation, and extrapolated site index curves indicated that the drainage treatments are economically feasible. A randomized complete block study of the effects of drainage and fertilization on sweetgum and sycamore was initiated in January, 1968. At the end of the first growing season, heights of sycamore seedlings in all treatments were greater than sweetgum heights in the same treatments. Heights of sycamore seedlings in the fertilized and drained treatment were statistically superior to those seedlings in the fertilized and undrained treatment. W69-08397

A NONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND CANALS, Mississippi State Univ., State College. Dept. of Agricultural and Biological Engineering For primary bibliographic entry see Field 08B. W69-08398

FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN,

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. Ralph A. Klawitter, and Cortland E. Young, Jr. J. Irr. and Drain. Div., ASCE, 91 (1R3):1-7, Sept.

Descriptors: *Drainage, *Reclamation, *Coniferous forests, *Wetlands, Water injury, Ditches, Drainage practices, Gulf coastal plain, Plant growth, Pine trees.

This paper represents preliminary information on expected increases in wetland soil productivity as a result of drainage. Results are based on a study in northwest Florida and a survey in coastal North Carolina. Soil productivity increases were assessed in terms of pine tree height and volume growth. W69-08437

DRAINAGE.

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. Ralph A. Klawitter.

Proc. Symposium on hardwoods of the Piedmont and Coastal Plain, Ga Forest Res Council, p 16-17, Oct 1966.

Descriptors: *Drainage, *Reclamation, *Wetlands, *Ditches, Drainage effects, Land management, Plant growth, Deciduous trees, Watershed manage-ment, Flood plains.

Site changes resulting from drainage of swamps and bottomlands will change stand composition, growth, and regenerative potential. Hundreds of miles of canals have already been dug to handle flow. One can only speculate about the effects on hardwood growth, fish and wildlife habitats, streamflow and soil-water levels. W69-08438

STREAMFLOW - AN IMPORTANT FACTOR IN FOREST MANAGEMENT IN THE COASTAL PLAIN,

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. For primary bibliographic entry see Field 02E. W69-08439

HYDROLOGY OF WETLAND FOREST WATERSHEDS,

Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station.
Cordland E. Young, Jr., and Ralph A. Klawitter.
Conference Proceedings - Hydrology in water resources management, WRRI Report No 4, Clemson Univ, S C, p 29-38, 1968.

*Hydrologic cycle, *Wetlands. *Storm runoff, *Evapotranspiration, Forests, Water balance, Runoff, South Carolina, Atlantic Coastal Plain, Watersheds (Basins), Water control, *Water management (Applied), Precipitation (Atmospheric).

The resource potential of coastal plain wetland forests can be greatly increased by scientific water management; however, this cannot be accom-plished without a basic knowledge of the hydrology of these areas. Preliminary results from a 400-acre wetland watershed on the Santee Experimental Forest show that average annual storm runoff was approximately twice that from forested watersheds in the Piedmont and mountains; furthermore, during wet periods peak runoff rates were double those computed for the watershed by an accepted drainage formula. Measured evapotranspiration was slightly greater than Thornthwaite's potential W69-08440

SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION: RESEARCH

FINDINGS - ORGANIC SOILS, Forest Service (USDA), Charleston, S. C. Southeastern Forest Experiment Station. Ralph A. Klawitter.

Proc South Soil Survey Work Planning Conf, USDA, S C S, Clemson Univ, 7 pp, Jul 1968.

Descriptors: *Drainage, *Reclamation, *Wetlands, *Soils, *Organic soils, Drainage effects, Trees, Coniferous forests, Land management, Watershed management, Soil management, Soil investigations.

The woodland owner needs to know the botanical origin and stratigraphy of the peat, as well as its thickness, degree of decomposition, wood content, acidity, water sources and hydraulic conductivity. The kind of subsoil material, amount of mineral and soil mixed into the peat, and natural fertility and vegetation are all information that will be put to use in selecting peatlands for woodland drainage and planting. Such detailed knowledge will be used not only in timber production, but in wildlife habitat improvement, in forage production, in water management and by engineers in road and other construction as well. W69-08441

WIND DAMAGES IMPROPERLY PLANTED SLASH PINE.

Forest Service (USDA), Charleston, S. Southeastern Forest Experiment Station. Ralph A. Klawitter.

South Lumberman, Mar 1, 1969. p 26.

Descriptors: *Drainage, *Reclamation, *Pine trees, *Winds, *Planting management, Forest management, Soils, Land management, Plant growth, Trees, Gulf coastal plain, Watershed management.

Planting techniques can affect the growth and development of tree seedlings as well as their susceptibility to wind damage. The paper describes how slash pine seedlings developed a noticeable lean on a drained area in northwest Florida and details the reasons: wind, wet soil and poor planting practice. W69-08442

WATER TABLE, SOIL MOISTURE, AND OXYGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, Forest Service (USDA), Charleston, S. C.

Southeastern Forest Experiment Station. Cortland E. Young, Jr. Soil Science, 107 (3):220-222, Mar 1969. 3 p, 2

fig, 10 refs.

Descriptors: *Water table, *Soil moisture, *Aeration, *Statistical models, *Forest soils, Wetlands, Forests, Atlantic Coastal Plain, Root zone, Regression analysis, Drainage, Water management (Ap-

Identifiers: *Oxygen diffusion rate, Plummer sand, Bayboro clay loam, Small plots.

Statistical models have been developed to express the relationship between (1) depth to water table and soil moisture content at 6- to 18-inches, and (2) depth to water table and oxygen diffusion rate at 12 inches. Measurements of the above parameters were made on two 1/10-acre plots at biweekly intervals over a 2-year period. The soil types sampled included Bayboro clay loam and Plummer loamy sand. Regression techniques were utilized in construction of the models. Results indicated that for the soils studied: (1) soil moisture content was negatively related to depth to the water table, and a complex equation was required to express the rela-

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Frankel.

Groundwater Management—Group 4B

tionships, and (2) oxygen diffusion rate was positively and linearly related to depth to the water ta-ble. Some of these models agreed with data published in the literature whereas others did not. The coefficients of determination were reasonably high for all the relationships. W69-08443

SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT RANGES.

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.

Earl F. Aldon, and George Garcia. US Forest Serv Res Note RM-95. 3 p.

Descriptors: *Ranges, Carrying capacity, Land management, *Forages, Vegetation establishment, Productivity, *Flood plains, *Erosion control. Identifiers: Range science, Forage production.

Research in west-central New Mexico showed alkali sacation on flood plains offers management its best chance for increasing productivity of semidesert lands. It is highly palatable, and can produce much herbage on a relatively small area. Under summer deferred grazing, production of alkali sacaton has been gradually increasing in spite of variable precipitation. W69-08462

DEFERRED GRAZING AND SOIL RIPPING IMPROVES FORAGE ON NEW MEXICO'S RIO PUERCO DRAINAGE, Forest Service (USDA), Albuquerque, N. Mex.

Rocky Mountain Forest and Range Experiment Station.

Earl F. Aldon. N Mex Stockman 31 (11): 44, 46.

Descriptors: *Erosion control, Soil surfaces, Soil structure, *Ranges, Soil stability, *Overland flow, *Forages.

Identifiers: Range science, Forage production, Ground cover.

Summer-deferred grazing significantly increased the ground-cover index and reduced sediment yields on the Rio Puerco drainage. Soil ripping also increased forage production. Largest gains in plant cover occurred on alluvial flood plains growing alkali sacation. W69-08463

AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN OPERATION OF A SYSTEM OF DAMS, Raytheon Co., Waltham, Mass.

Murray Mannos. Econometrica, Vol 33, No 3, p 335-336, July 1955.

Descriptors: *Linear programming, *Reservoir operation, *Power operation and maintenance, Optimization, *Multiple purpose reservoirs, *Variability, Reservoir storage, Approximation method, Dams, Missouri River, Hydroelectric

Linear programming techniques were used to determine the optimal operation of a system of six multipurpose dams on the Missouri River. Power generation was one of the considerations. The objective of the research was to determine variations in the reservoir storages, so as to maximize the energy obtained from the entire system. Physical limitations on the storages and releases appeared in the form of inequality constraints. An approximation to a change in energy was given as a linear function of the storage variations. (Thiuri-Cornell) W69-08536

CHINKING UP SOME CRACKS, Federal Water Pollution Control Administration, Washington, D. C. Div. of Technical Control. For primary bibliographic entry see Field 06A.

W69-08539

RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE NETWORKS.

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02E. W69-08571

TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS.

Iowa State Univ., Ames. Dept. of Agronomy. For primary bibliographic entry see Field 02F. W69-08576

FLOOD PLAIN INFORMATION NEUSE AND TRENT RIVERS AND JACK SMITH CREEK, NEW BERN, NORTH CAROLINA. Corps of Engineers, Wilmington, N. C

Corps Eng Flood Plain Rep, May 1969. 42 p, 10 fig, 11 plate, 4 tab. Prepared for the city of New Bern.

Descriptors: *Floods, *Flood damage, *North Carolina, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: New Bern (N C), Standard project flood, Intermediate regional flood.

Flooding of the Neuse and Trent Rivers, New Bern, North Carolina is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regula-tions, the construction of flood protection works, or by combinations of these appraoches. (Knapp-USGS) W69-08593

FLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE MAY COUNTY, NEW JERSEY. Corps of Engineers, Philadelphia, Pa.

Corps of Eng Flood Plain Rep, June 1968. 70 p, 14 fig, 11 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic

Identifiers: Cape May County (NJ), Standard project flood, Intermediate regional flood.

Flooding of Cape May Co., New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construc-tion of flood protection works, or by combinations of these approaches. (Knapp-USGS) W69-08609

FLOOD PLAIN INFORMATION, UPHAM BROOK, HENRICO, VIRGINIA. Corps of Engineers, Norfolk, Va.

Corps Eng Flood Plain Rep, May 1968. Main Rep, 14 p, 6 fig, 7 photo. Tech append, Text, 7 plate, 4 tab, 2 exhibits.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Henrico County (Va), Upham Brook, Standard project flood, Intermediate regional

Flooding of Upham Brook, Henrico County, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS) W69-08610

4B. Groundwater Management

CALIFORNIA'S DIGITAL COMPUTER PROACH TO GROUNDWATER BAMANAGEMENT STUDIES, BASIN

California State Dept. of Water Resources. Ernest M. Weber, Helen J. Peters, and Michael L

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 215-223, 1968. 9 p, 4

Descriptors: *Mathematical models, *Ground-water basins, *Water management (Applied), *Systems analysis, *California, Simulation analysis, Optimization, Data processing, Digital computers, Economics, Aquifers, Water yield, Hydrologic budget, Water storage, Surface waters, Ground-

water. Identifiers: Groundwater basin management (Calif).

The California Department of Water Resources has been developing since 1959 a computerized approach to the planning studies of integrated management of groundwater and surface water supplies, storage and transmission. Formulation and economic comparison of a wide range of alternative plans required development of computer models of the groundwater basin and the surface water delivery system, and computer programs for developing cost of each alternative plan of in-tegrated operation under study. A 2-space dimen-sional-diffusion mathematical model of the groundwater basin has been developed which incorporates the nonlinear features of transmissibility variation with saturated thickness, rising and repercolating waters, and transmissibility variation at depth. Selection of the digital approach is related to data availability and the sensitivity of the economic analysis to the scale of the physical model. Digital model validation is speeded by on-line hydrograph plots. The diffusion model is also used for analysis of the surface delivery system. The economic analyses are restricted to physically feasible plans. Variable costs for each plan are developed. (Knapp-USGS) W69-08235

GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESE).

(JAFANESE), Industrial Science and Technology Agency, Kawasaki (Japan). Geological Survey. For primary bibliographic entry see Field 02F. W69-08248

GEOLOGY AND GROUNDWATER OCCURRENCE IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO,

Geological Survey, Washington, D. C. For primary bibliographic entry see Field 02F. W69-08287

GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS, Geological Survey, Washington, D. C.

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

For primary bibliographic entry see Field 02F. W69-08288

THE CONTROL OF GROUNDWATER OCCURRENCE BY LITHOFACIES IN THE GUADALUPIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO,

Massachusetts Univ., Amherst.

Ward S. Motts. Bul, Geol Soc Amer, Vol 79, No 3, pp 283-298, March 1968. 16 p, 8 fig, 4 pls, 18 ref.

Descriptors: *Groundwater movement, *New Mexico, Groundwater barriers, Aquifer characteristics, Deep percolation, Base flow, Flow characteristics, Geomorphology, Obstruction to flow, Subsurface flow, Underground streams, Carbonate rocks, Caves, Geohydrologic units, Geologic control, Geologic formations

trol, Geologic formations.
Identifiers: *Lithofacies, Pecos River, Guadalupian Reef Complex.

It was determined that occurrence and movement of water in the Guadalupian Reef complex of southeastern New Mexico is controlled primarily by lithofacies. The following major Guadalupian lithofacies are described and related to regional inthotaces are described and related to regional hydrology: (1) a basin facies of very low permeability which confines groundwater, (2) a reef-zone facies of very high permeability, (3) a shelf-carbonate facies ranging from very high permeability near the reef-zone to low permeability near the shelf-evaporite facies and (4) a shelf-evaporite facies of moderate permeability. Permeability is greatest in coarser-grained rather than fine-grained detrital carbonates and in calcareous rather than dolomitic rocks. The presence of potable water west of the Pecos River and the highly mineralized water east of the Pecos in rocks of similar stratigraphic position indicates that the Guadalupe and Sacramento fault blocks were uplifted and trenched by the Pecos River. Highly mineralized water from the west drained into the river and fresh meteoric water could then circulate toward the Pecos River discharge area, causing extensive solution of the limestone rocks. (Sherbrooke-Ariz) W69-08294

GROUNDWATER POTENTIAL OF KARST AQUIFERS IN SAUDI ARABIA, Ministry of Agriculture and Water, Riyadh (Saudi Arabia); and Food and Agriculture Organization of the United Nations, Rome (Italy). For primary bibliographic entry see Field 02F. W69-08296

GROUND WATER OF THE WESTERN DESERT

IN IRAQ, Baghdad Univ. (Iraq). Dept. of Geology. For primary bibliographic entry see Field 03C. W69-08298

WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., Geological Survey, Tucson, Ariz. Water Resources

For primary bibliographic entry see Field 02F. W69-08299

SURFACE-WATER INFILTRATION GROUNDWATER MOVEMENT IN AND ARID

ZONES OF VENEZUELA, Instituto Venesolano de Investigaciones Cientificas, Caracas. M. A. Tamers.

Symposium on Isotopes in Hydrology, Vienna, 1966, Proceedings pp 339-353, 1967. 15 p, 5 fig, 1

Descriptors: *Aquifer characteristics, *Radiocarbon, Arid lands, Evaporation, Aquifers, Artificial recharge, Carbonate rocks, Radioactive dating, Bicarbonates, Carbonates, Deepwells, Faults (Geology), Groundwater movement, Groundwater recharge, Overdraft, Natural recharge, Arid climates, Age, Infiltration, Surface runoff, Rainfall, Permeability, Transpiration. Identifiers: *Venezuela.

Radiocarbon dating of the carbonate species present in groundwater was utilized to obtain information on the recharge of underground deposits as well as directions and rates of movement. Dissolved carbonates are of two types: modern carbon is from the atmosphere (CO sub 2) and products of plants in the soil, while ancient carbon comes from dissolving limestones. The later is essentially free of radiocarbon, causing falsely old dates for the total groundwater carbonates. Adjustments of the dates were made for the limestone contribution employing bicarbonate and total carbon concentrations. Aquifers of Barquisimeto, Maracaibo, Coro, Paraguana and Valencia in Venezuela were investigated. Ages ranged from modern to 35,000 yr. The predominance of oldwater correlates well with the arid climatic conditions. Some 'modern' artificial recharge occurred from irrigation waters. Infiltration from rivers and lakes was studied. The rapid depletion of these aquifers and their importance to the Venezuelan economy is discussed. (Sherbrooke-Ariz) W69-08306

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, Nevada Univ, Reno. Dept. of Civil Engineering; and Nevada Univ, Reno. Center for Water Resources Research.

For primary bibliographic entry see Field 05D. W69-08625

4C. Effects on Water of Man's Non-Water Activities

BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMM'N (WATER DAMAGE FROM DIVERSION).

108 SE2d 912-917 (NC 1959).

Descriptors: *North Carolina, *Water injury, *Road construction, *Diversion, Diversion structures damages, Judicial decisions, Legal aspects, Administrative agencies, State governments, Eminent domain, Easements, Property values, Flooding, Flood damage, Natural flow, Stream flow, Obstruction to flow.

Plaintiff's land and home were located in a subdivision adjacent to a highway still under construction. During the highway construction, defendants diverted a stream which on several occasions caused flood damage to plaintiff's home and property. Defendants admitted the diversion but contended that liability could be imposed on a governmental agency only for damages resultant from negligence in the road construction. Plaintiffs based their claim on the general rule that liability exists for damage resulting from a diversion of water and on the rule that the right to have water flow in the direction provided by nature is a property right which must be compensated for when destroyed. The court held for plaintiffs on their contentions above and noted that negligence need not be alleged to create liability for a diversion. (Carruthers-Fla) W69-08311

HACKENSACK WATER COMPANY V VILLAGE OF NYACK (ACTION TO RECOVER FOR WITHDRAWAL LOSS). 289 F Supp 671-686 (SDNY 1968).

Descriptors: *New York, *Utilities, *Withdrawal, *Diversion losses, Prescriptive rights, Judicial decisions, Local governments, Cities, Reasonable use, Riparian rights, New Jersey, Diversion, Stream flow, Compensation, Consumptive use, Return flow, Alteration of flow, Damages, Remedies, Water Works, Relative rights, Appropriation, Water users, Legislation.

Plaintiff water service company owns riparian lands in New Jersey along a river. The land is located five miles from the point where the defendant's water works obtain water from the river. Plaintiff asserted that defendant's diversion rendered the flow in-adequate to meet plaintiff's water supply require-ments. Plaintiff sought compensation for the withdrawal and diversion. Under both New Jersey and New York law, the upstream riparian owner may not unreasonably divert or appropriate waters of a flowing stream. The question of what constitutes reasonable use by a riparian owner is one of fact, thus, a summary judgment cannot be given. Since New York statute required the giving of notice within ninety days after the claim for damages arose, the plaintiff was barred from recovering damages incurred more than ninety days prior to the service of notice. The grant by the New York Water Resources Commission of the right to divert water without making compensation to the lower riparian owner would constitute a taking of property without compensation. (Childs-Fla) W69-08312

LAYING OUT, ALTERING AND DISCONTINU-

ING HIGHWAYS. Me Rev Stat Ann, Tit 23, Secs 652, 705 (1965), 651 (Supp 1968).

Descriptors: *Maine, *Highways, *Ditches, *Culverts, Legislative, Administrative agencies, Damages, Drains, Easements, State governments, Highway relocation, Civil engineering, Road construction, Roads, Drainage, Assessments, Construction, Flow, Remedies, Legal aspects.

The state highway commission may construct ditches and drains to carry water away from any highway under its supervision, and over or through any lands when it deems it necessary. No such ditch or drain shall pass within 20 feet of any dwelling without the owner's consent. Wherever, along a highway, ditches or drains have existed for over 20 years, there shall be a conclusive presumption that easements for flowage from such ditches or drains exist, but only to the extent of the original flowage If the change in grade of any state or state aid highway injures an adjoining landowner, he may apply to the commission within 6 months for a determination and assessment of his damages, and if they are unable to settle the damages, then to the Land Damage Board. An adjoining landowner may also petition the commission to have a culvert installed to provide an entrance to his property. Such culvert shall be maintained by the commission. (Heckerling-Fla) W69-08314

CAMPBELL V STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDEMNATION OF A SPRING AND AN EASEMENT). 165 SE2d 281-285 (Va 1969).

Descriptors: *Virginia, *Springs, *Water rights, *Easements, *Condemnation, Judicial decisions, Legal aspects, Water contracts, Water supply, Pipelines, Water rates, Confined water, Wells Reservoirs, Right-of-way, Cities, Damages, Road construction, Pumps, Water delivery, Compensation, Land tenure, Condemnation value.

Plaintiffs brought suit against the defendants to recover compensation for a spring taken in a condemnation proceeding. The spring was on property adjacent to the plaintiffs and the plaintiffs had obtained an easement to the spring and for water pipes across the adjacent property. The property where the spring was located was condemned by the defendant. The defendants claimed that the water supply appropriated by the defendants was replaced by water purchased from a nearby city. The court held the plaintiffs were entitled to

Watershed Protection—Group 4D

damages without any offset for the value of the city water supply. The court stated that the conveyance to the plaintiffs of the spring was a valid conveyance of a property right. Defendants further contended that plaintiffs had agreed to what amounted to a waiver of damages with the city water as consideration. The court held that defendants had not proved this point. The court felt that the plaintiffs were entitled to just compensation for the value of the spring and easements that were taken and remaned the case for a determination of these damages. (Shevin-Fla)

STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. SC Code Ann secs 33-167, 33-170, 33-171 (1962).

Descriptors: *South Carolina, *Dams, *Water control, *Road construction, *Cost sharing, Transportation, Highways, Flood control, Drainage systems, Gutters, Flow control, Administrative agencies, Legislation, Routing, Water, Water conveyance, Conduits, Levees, Costs, Cost allocation, Project planning, Legal aspects, Roads, Bridges, Local governments.
Identifiers: Water-controlling devices.

When the cost of construction or repair of any highway would be reduced by 1/3 with the construction of a water-controlling device in connection therewith, the State Highway Department may authorize the construction of such device along with the bridge and approach thereto and may share the cost with any local government affected thereby. The Department may expend 2/3 of the amount necessary to cross any waterway without a water-controlling device. The remainder shall be borne by the local government. The construction, authorized by section 33-112 may include provisions for sidewalks, parking, gutters, storm sewers, and other such devices essential for highway service and maintenance and to preserve and protect the highway investment. Municipalities may, with Department approval, maintain such city utilities within the highway right-of-way as are in accord with sound engineering practices. All concomitant expenses thereto shall be borne by the municipality. (Helwig-Fla) W69-08338

FLOATING TIMBER AND DAMAGE THEREFROM.

NH Rev Stat Ann secs 489:1 thru 489:12 (1968).

Descriptors: *New Hampshire, *Lumbering, *Transportation, *Riparian rights, Legislation, Legal aspects, Land tenure, Right-of-way, Banks, Remedies, Damages, Rivers, Streams. Identifiers: Larceny of logs, Penalties (Civil).

The owner of improved land on which floating timber has lodged may detain the timber. He must post notice of any such timber detained. He may then hold the timber until the timber owner either pays damages and removal costs or gives a bond at least twice the value of the property detained. If the parties cannot agree on the damages, either one may request the selectmen for an assessment. Either party may appeal this assessment. The timber owner has five months from the posting of the notice to pay the damages, or give a bond, and remove the timber. Otherwise the landowner may convert the timber to his own use and recover damages in an action against the timber owner. The owner of unimproved land may detain lodged timber until the damages are paid. Anyone removing the lodged timber without payment of damages is liable to the landowner. Interference with the flow of logs, destruction of their markings, or fraudulent conversion of timber floating and on the banks all constitute criminal offenses. (Breeze-Fla)

GOLDIN V TRUSTEES OF VILLAGE OF EL-LENVILLE (INTERFERENCE WITH WATER SUPPLY BY CITY).

296 NYS2d 1017-1019 (NY App Div 1969).

Descriptors: *New York, *Pipelines, *Water supply, Judicial decisions, Legal aspects, Local governments, Relative rights, Proprietary power, Pipes, Cities.
Identifiers: *Deeds, *Covenants, Injunction, Warranty deeds.

A village laid a pipeline through a farm by right of a warranty deed. The deed required the village to place a tap on the line near the specified tenant house to allow the landowners to draw free water. The water was for the use of the tenant family and livestock in a particular barnyard. The successors in title to a portion of the land sued to compel the village to furnish them with free water. The court affirmed a judgment to dismiss the complaint. The court held that the successors' claim must fail in absence of evidence that the particular tenant house and barnyard stipulated in the deed were once located on the successors' land. (Breeze-Fla) W69-08355

ROAD CONSTRUCTION.

SC Code Ann sec 33-851 (1962).

Descriptors: *South Carolina, *Highways, *Road construction, *Ditches, Transportation, Flooding, Streams, Surface water, Surface runoff, Roads, Roadbanks, Embankments, Civil engineering, Grading, Slopes, Design, Road design, Washouts, Culverts, Construction, Legislation, Legal aspects, Local governments, Root development, Root systems, Flow, Streamflow. Identifiers: Mileposts.

The roadbed of a road constructed in this state shall not be more than 16 feet wide exclusive of ditches and other obstructions. Roads through lands where water stands or flows must be ditched and the road bed raised. (Helwig-Fla) W69-08365

STATE EX REL TETER V STATE ROAD COM-MISSION (DAMAGE ASCERTAINMENT).

166 SE2d 757-761 (W Va 1969).

Descriptors: *West Virginia, *Condemnation, *Surface waters, *Condemnation value, Flood damage, Damages, Highways, Road construction, Eminent domain, Flooding, Land use, Land tenure, Compensation, Judicial decisions, Legal aspects, Drainage, Surface runoff. Identifiers: Proceeding in mandamus.

Petitioners, as joint owners of property allegedly damaged by the construction of a new highway adjacent thereto, brought a proceeding in mandamus to compel the State Road Commissioner to institute condemnation proceedings against them to ascertain the amount of damage. Petitioners' property drained in a westerly direction across the site of the highway. Construction allegedly raised the elevation of this area and blocked this natural drainage. This caused surface water to flood their drainage. This caused surface water to flood their properties, damaging the land and buildings situated thereon. Evidence as to the extent of the damage was conflicting. The court held that where highway construction allegedly causes surface waters to flood property, an opportunity for judicial determination of any bona fide damage claim should be afforded the owners. The mandamus writ was granted. (Carruthers-Fla) W69-08375

4D. Watershed Protection

KEEP MAINE SCENIC; ALLAGASH RIVER AUTHORITY. For primary bibliographic entry see Field 06E.

W69-08131

SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS, Agricultural Research Service, Oxford, Miss. Sedi-

mentation Lab.

For primary bibliographic entry see Field 02J. W69-08223

SHORE EROSION CONTROL DISTRICTS.

Md Ann Code Art 25, secs 167A-167E (1957), as amended, (Supp 1968).

Descriptors: *Maryland, *Erosion control, *Local governments, *Bodies of water, Estimated costs, Feasibility studies, Erosion, Legislation, State jurisdiction, Artificial watercourses, Lakes, Rivers, Streams, Construction costs, Shores, Shore protection, Administrative agencies Identifiers: *Erosion control districts.

The property in any county or Baltimore City abutting on any artificial or natural body of water in the state, whether tidal or nontidal, may be formed into a shore erosion control district. The owners of 75% of any property or 75% of the owners of any property may petition the county commissioners requesting the formation of a district. The petition shall describe the boundaries of the proposed district. The commissioners shall refer the petition to the shore erosion control section of the Department of Tidewater Fisheries which shall review the petition and report to the commissioners on the feasibility and need for a district. The report shall include the area to be included, plans for erosion control, and estimated costs. The commissioners are authorized to finance erosion control projects in the manner set out elsewhere in this article. (Kahle-Fla) W69-08333

SOIL CONSERVATION DISTRICTS.

Md Ann Code Art 66C sec 89 (1957).

Descriptors: *Maryland, *Soil conservation, *Land management, *Political aspects, Drainage, Land, Land development, Legislation, Wildlife management, Mass wasting, Terracing, Erosion, Soil stabilization, Surface runoff, Ponds, Dikes, Flood control, Irrigation systems, Water resources, Area redevelopment, Local governments, Erosion controls, and the property of the control of the property of the redevelopment, Local governments, Erosion control, Check structures.

Since agricultural lands are among the basic assets of the state, the state's policy is to preserve such lands in order to protect the health, safety, and general welfare of its people. Improper land practices have caused serious wind and water erosion of farm and grazing lands. This results in the loss of much topsoil. Failure of one owner to conserve the soil of his lands makes conservation of soil on other lands impossible. The consequences of such misuse include silting and sedimentation in stream channels, reservoirs, and dams, deterioration of soil productivity, destruction of cover and food for wildlife, and a diminishing of the underground water reserve. The correction of such problems by promotion of such appropriate soil conservation and land use practices as use of terraces, checkdams, dikes, ponds, strip cropping, land irrigation, rotation of crops and soil stabilization with trees or grasses is the policy of this state. (Johnson-W69-08336

SOIL CONSERVATION AND IMPROVEMENT. SC Code Ann, secs 63-211, 63-294, 63-302, 63-325 thru 63-327 (1962).

Descriptors: *South Carolina, *Administrative agencies, *Soil conservation, *Beach erosion, Local governments, Federal government, Flood control, Conservation, Drainage, Drainage dis-tricts, Land, Land development, Legislation, Legal

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4D—Watershed Protection

aspects, Water policy, Erosion control, Land management, Soil management, Beaches, Governments, Encroachment.

Preservation and prevention of erosion on beaches in Charleston County being the responsibility of the county governing body, it must cooperate with all agencies of the United States Government to this end. However, it may deal with the federal government only when there is no state agency qualified to deal with problems of erosion and beach preservation. The Pawleys island erosion commission, composed of residents, of Georgetown County, is charged with making a study of the problem of beach erosion in the district and ways of retarding or preventing such erosion. It has power to construct and maintain such groins or other structures as are necessary to protect such beaches from encroachment by the ocean. The Greenvill County soil conservation district may acquire by condemnation such rights of way as are necessary for any authorized function of the district including acquisition of land for flood water retarding structures and flood plain boundaries. The Harry County Beach Preservation Association is charged with prevention and control of beach erosion within its district and enjoys official agency status which authorizes dealing with federal agencies. (Johnson-W69-08370

SURFACE RUNOFF AND EROS.

LOWER CHAPARRAL ZONE, ARIZONA,

(ISDA) Tempe, Ariz. Rocky

Mountain Forest and Range Experiment Station. Lowell R. Rich

Forest Service USDA, Rocky Mountain Forest and Range Experiment Station. Station pap 66, 1961. 35 p, 12 tab, 20 fig.

Descriptors: *Erosion, *Chaparral, *Planting management, Thunderstorms, *Vegetation effects, Overland flow, Sediment yield. Identifiers: *Granitic soils, *Hardware-cloth checks, Plant cover, Perennial grass.

This paper discusses the effect of recovery of vegetation, mechanical stabilization, and cover changes on storm runoff, and sediment yields from nine small watersheds located on granitic soils in the lower chaparral zone. Intense summer thunderstorms are characteristic of Arizona. Where plant cover is sparse and infiltration capacity low surface runoff (overland flow) maybe high. Surface flows may carry considerable sediment and generally increase erosion. To control erosion, management must be directed toward reduction of surface runoff. Overland flow and erosion were reduced, and a perennial grass cover was established by cutting woody vegetation, and seed-ing to Boer and Lehmann lovegrass. Hardwarecloth checks placed on the contour reduced erosion but did not produce additional vegetation. Most surface runoff was produced during the summer W69-08474

EROSION AND SEDIMENT MOVEMENT FOL-LOWING A WILDFIRE IN A PONDEROSA PINE FOREST OF CENTRAL ARIZONA, Forest Service (USDA) Tempe, Ariz.

Rocky Mountain Forest and Range Experiment Station. L. R. Rich.

USDA Forest Service Rocky Mountain Forest and Range Experiment Station, Res Note 76, 1962. 11

Descriptors: *Erosion, *Sediment transport, *Water yield, Ponderosa pine trees, Peak discharge, Sampling, Profiles, Streamflow, Cross-

Identifiers: *Wildfire, Weir basin, Sediment trap, Experimental watersheds.

A hot wildfire burned 60 acres in the upper part of South Fork of Workman Creek Experimental Forest. The fire was not planned, but the watershed

instrumentation lent itself to a fairly detailed sampling of fire effects. The fire destroyed 74 percent of the basal area of trees in the burn. The first storm after the fire was one of the most intense measured to that date. During the first summer, under nearly average total rainfall, approximately 1 acre-foot of sediment (an average of 0.016 foot) was eroded from the burn. Sediment was deposited immediately below the burn, in unburned forest vegetation, in the stream channel and in the weir pond. Only 2 percent was trapped in the weir pond, but even this was much more than before the fire. Summer storm peaks were higher than before the fire, but these higher peaks did not result in increased annual streamflow. W69-08475

GAZING IN RELATION TO RUNOFF AND EROSION WATERSHEDS OF CENTRAL ARIZONA, ON SOME CHAPARRAL Forest Service (USDA), Tempe, Ariz.

Mountain Forest and Range Experiment Station. Lowell R. Rich, and Hudson G. Reynolds J Range Manage 1963, 16 (6) 322-326, illus.

Descriptors: *Runoff, *Erosion, *Grazing, *Livestock, *Wildlife habitats, Cacti, Shrubs, Watershed management.

Identifiers: *Chaparral watersheds, Forbs, Half-Perennial shrubs. grasses, Experimental watersheds.

Vegetation, water and sediment were measured on four watersheds varying in size from 9.1 to 19.5 acres between 1935 and 1952. Two watersheds were grazed while two served as checks. Precipitation averaged 20.7 inches, streamflow from one ungrazed watershed 1.9 inches and sediment losses averaged 17 to 132 tons per square mile per year. Grazing 80 percent of the growth of perennial grasses reduced their basal cover. Grazing 40 percent of perennial grasses did not adversely affect basal cover. Reduction in basal area of perennial grasses by grazing for conditions measured had no significant or practical effect on total water yield. Proper grazing of perennial grass-shrub complexes in the chaparral of central Arizona had no measurable effect upon water production or erosion. W69-08476

EFFECT OF GRAZING ON INFILTRATION IN

A WESTERN WATERSHED, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. J. R. Thompson.

J Soil and Water Conserv 1968, 23 (2): 63-65, illus.

Descriptors: *Infiltration, *Grazing, *Infiltrometers, Soil-water-plant relationships, *Erosion control, Soil management, Soil surfaces, Overland

Identifiers: Infiltration measurements.

Infiltration measurements on grazed and ungrazed watersheds in the fall of 1953, 1954, 1958, and 1963, along with personal observations at other seasons of the year, suggest that seasonal variation in surface soil characteristics of the Badger Wash basin, in western Colorado overshadow any effects that might be attributed to protection from grazing. There are indications that proper soil management to maximize surface fluffiness could effectively reduce erosive runoff from high intensity rainstorms of short duration. W69-08479

BURNED CHAPARRAL TO GRASS: EARLY EF-FECTS ON WATER AND SEDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN ARIZONA.

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 03B. W69-08485

AN APPLICATION OF MULTIVARIATE ANAL-YSIS TO SEDIMENT NETWORK DESIGN, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07A. W69-08497

SOME INTERPRETATIONS OF SEDIMENT SOME INTERPRETATIONS
SOURCES AND CAUSES, PACIFIC COAST
BASINS IN OREGON AND CALIFORNIA,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 02A. W69-08501

SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION,
Forest Service (USDA), Berkeley, Calif. Pacific

Southwest Forest and Range Experiment Station. Henry W. Anderson.

International Symposium on Forest Hydrology, Proc (1965): 701-702 Pergamon Press - Oxford and New York -- 1966.

Descriptors: *Review, *Erosion control, *Forest soils, *Soil stability, *Landslides, Vegetation effects, Watershed management.

Summarizes papers presented at the session of forests and soil stabilization at the International Symposium on Forest Hydrology and comments on the status of the science. Discusses the rather unique characteristics of forest sites and how these make for difficulty in evaluating the true consequences of disturbances of forest watersheds. Typically, forest soils are deep or have large volumes of loose mantle material, built up under the forest vegetation. The surface soil layers have high infiltration and percolation capacity; they often occupy 'over-steepened' slopes, with the soil anchored by the tree roots. The 'over-steepened' slopes imply an erosion process of channel downcutting over long periods of time and of mass creep and occasional mass sliding from lower slopes into the channels. W69-08502

WATERSHED IMPORTANT CHARAC-TERISTICS AFFECTING WATER YIELD, FLOOD PEAKS AND EROSION AND SEDIMEN-TATION AND THE BASIC DATA NEEDED FOR PRODUCTION,

Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station; and Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Howard W. Lull, and Henry W. Anderson.

For 8 Volume Proceedings see Vol 2, No 9, Field 6B, W69-03305. Int Conf Water for Peace, p 431, (1967): 1-8.

Descriptors: *Hydrologic properties, *Watersheds (Basins), *Analytical techniques, *Water yield, *Peak discharge, *Sediment yield, Erosion control, Forecasting, Statistics, Climatic data, Watershed management.

Identifiers: *Data needs, *Sediment sources, *Watershed variables, Experimental watersheds.

Predictions of water yield, floods, erosion, and sedimentation must take into account the environment factors, the nature of the watershed, and its past history. Methods of selection and evaluation of variables which characterize processes determining annual, seasonal and daily water yield and river forecasting are discussed. The variables affective flood peak discharge from small watersheds are discussed under headings of precipitation, area, soil and geology, topography and land use. Special variables involved in sedimentation processes are outlined. Sources of data and analytical procedures are briefly reviewed. W69-08508

Identification of Pollutants - Group 5A

WHEN IS IT SAFE TO EXTEND A PREDIC-TION EQUATION--AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07B. W69-08509

OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES SYSTEM, California Univ., Los Angeles. Water Resources

For primary bibliographic entry see Field 06A W69-08540

THE SEDIMENTOLOGY OF A BRAIDED RIVER.

Ottawa Univ., Ontario. Dept. of Geology. For primary bibliographic entry see Field 02J. W69-08580

'PEBBLE CLUSTERS': THEIR ORIGIN AND UTILIZATION IN THE STUDY PALAEOCURRENTS.

Ferrara Univ. (Italy). Inst of Geology For primary bibliographic entry see Field 02J. W69-08608

GLACIAL AND FLUVIO-GLACIAL FORMA-TIONS OF THE LYON REGION (FRENCH), Lyon Univ. (France). Dept. of Earth Sciences For primary bibliographic entry see Field 02C W69-08627

05. WATER OUALITY MANAGEMENT AND **PROTECTION**

5A. Identification of Pollutants

Fe, Mn, Ni, Co, Sr, Li, Zn, and SILICA IN STREAMS OF THE LOWER KANSAS RIVER BASIN,

Kansas State Geological Survey, Lawrence; and

Kansas Univ., Lawrence. Kansas Univ., Lawrence. E. E. Angino, O. K. Galle, and T. C. Waugh. Contract No PH86-66-63 (FWPCA). Water Resources Res, Vol 5, No 3, pp 698-705, June 1969. 8 p, 2 fig, 3 tab, 18 ref.

Descriptors: *Water chemistry, *Trace elements, *Kansas, Geology, Solutes, Aqueous solutions, Iron, Manganese, Cobalt, Silica, Provenance, Adsorption, Sampling.

Identifiers: *Kansas River Basin, Nickel, Strontium, Lithium, Zinc

An attempt is made to ascertain the background levels and to measure seasonal variations of selected trace and minor elements in the major streams of the Lower Kansas River Basin. Knowledge of the trace element chemistry of river waters is becoming increasingly more important as the rate of use of stream waters increases. Excepting the case of strontium, no strong relation between trace element concentration and geology or lithology was noted. To ascertain properly trace element background levels in streams, long-term sampling covering at least I seasonal cycle is essen-Variations in drainage basin geology have only a minor controlling influence on the trace element geochemistry of the wastes studied. The low values of nickel and cobalt are probably due to adsorption of these elements on the suspended load. (Knapp-USGS) W69-08204

TRANSFER OF OXYGEN IN AQUEOUS SOLU-

TIONS, Hydroscience, Inc., Leonia, N. J. Edwin L. Barnhart.

ASCE Proc, J Sanit Eng Div, Vol 95, No SA3, Pap No 6639, pp 645-661, June 1969. 17 p, 11 fig, 5 tab, 24 ref, append.

Descriptors: *Oxygenation, *Dissolved oxygen, *Aqueous solutions, *Water treatment, *Surfactants, Mass transfer, Diffusion, Solubility, Solutes, Boundary processes, Bubbles, Water chemistry, Water temperature.

Identifiers: Oxygen transfer (Bubbling).

The paper reports the results of studies which describe the influence of geometry and tempera-ture on the liquid film coefficient and the mass transfer coefficient for the transfer of oxygen from air bubbles rising in a liquid. It is shown that the liquid film coefficient is related to the total drag force operating at the liquid gas interface. The influences of several surface active agents are discussed. At low concentrations, the principle influence of surface active agents is their effect on the bubble size and rate of rise. (Knapp-USGS) W69-08217

ODOROUS COMPOUNDS IN WATERS-2-EXO-HYDROXY-2-METHYLBOR-NANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL ACTINOMYCETES, California Univ., Berkeley. Col. of Engineering; and California Univ., Berkeley. Dept. of Chemistry. Lloyd L. Medsker, David Jenkins, and Jerome F. Thomas.

Environ Sci and Tech, Vol 3, No 5, pp 476-477, May 1969. 2 p, 3 fig, 5 ref.

Descriptors: *Water pollution effects, *Odor, *Actinomycetes, Stagnant water, Taste, Water pollution sources, Bacteria, Spectrophotometry, Pollutant identification. Identifiers: Odor-producing bacteria.

One major odorous constituent in natural waters is the camphor-smelling compound 2-exo-hydroxy-2-methylbornane. Based on a survey of 28 species of Actinomycetes, the findings pinpoint three organisms--Streptomyces antibioticus, Streptomyces praecox, and Streptomyces griseus--as the produ-cers of the odorous constitutent. (Knapp-USGS) W69-08219

OLEFINS OF HIGH MOLECULAR WEIGHT IN

TWO MICROSCOPIC ALGAE,
Houston Univ., Tex. Dept. of Chemistry; Houston
Univ., Tex. Dept. of Biology; and Houston Univ.,
Tex. Dept. of Biophysical Sciences.
E. Gelpi, J. Oro, H. J. Schneider, and E. O.

Science, Vol 161, No 3842, pp 700-701, August 1968. 2 fig, 1 tab, 23 ref.

Descriptors: *Algae, Cyanophyta, Chrysophyta, Cultures, Diagenesis, Sediments, Gas chromatography, Lipids, Oil, Oil shale. Identifiers: *Botryococcus braunii, *Anacystis montana, *Hydrocarbons, *Olefins, Green River formation, Chlorophyll derivatives, Recent sediments. Precembrian, sediments. Chlorolla, pyrocambrian, sediments. Chlorolla, pyrocambrian, sediments. ments, Precambrian sediments, Chlorella pyre-noidosa, Fucales, Alkanes, Alkenes, Aliphatic hydrocarbons, Petroleum crudes, Mass spec-trometry, N-heptadecane, Monoenes, Dienes, Trienes.

Utilizing gas chromatography and mass spectrometry, authors studied the hydrocarbon composition of two species of algae: Botryococcus braunii, a golden-brown (chrysophyte), and Anacystis montana, a blue-green (cyanophyte). Hydrocarbons of the chrysophyte are alkenes with one, two, or three double bonds; and odd numbers of carbon atoms (in range, 17-33). Diolefins with 27, 29 or 31 carbon atoms predominate, that of 29 carbons being major component. Distribution in the cyanophyte comprises primarily monoenes with carbon atoms in range, 19-29, the major component being a monoene of 27 carbons. Heptadecane, only paraffin found, constituted 11.5% of hydrocarbons found in anacystis. Consideration of information developed in this study, together with data reported elsewhere in the literature, led authors to the following conclusions: hydrocarbons of high molecular weight are found in contemporary counterparts of ancient microscopic organisms; such hydrocarbons are present in high cellular concentrations (0.1-0.3% of dry cell weight); they possess high degree of unsaturation; they show marked odd over even predominance; and they show actual and potential similarities with patterns of ancient and modern sediments and oil shales. (Eichhorn-W69-08284

DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRA-TION.

Dohrmann Instruments Co., Mountain View, Calif. Robert T. Moore, and James A. McNulty. Environ Sci and Tech, Vol 3, No 8, p 741-744, Aug 1969. 4 p, 5 fig, 2 tab, 5 ref.

Descriptors: *Analytical techniques, *Chemical analysis, *Water analysis, *Nitrogen compounds, Organic compounds, Nutrients, Nitrates, Chromatography, Ammonia, Gas chromatography. Identifiers: Nitrogen analysis, Microcoulometric

A new and rapid instrumental technique has been developed to measure the total of both organically and inorganically bound nitrogen in water. Conceived as a replacement for normal Kjeldahl procedures, the sytem yields duplicate analyses down to 0.2 ppm in under 10 min. The sample is pyrolyzed over a granular nickel catalyst in a stream of humidified hydrogen, the bound nitrogen in the sample being converted quantitatively to ammonia and subsequently titrated electrochemically in a pH-sensitive cell. Suitable for use with partitioning procedures, specific scrubbers, and gas chromatography, the technique is capable of rapidly revealing the organic and inorganic nitrogen spectrum in water samples. Equivalent results are obtained where the sample matrices are the typical hydrocarbons used in partitioning. (K-napp-USGS) W69-08559

NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES, Michigan Univ., Ann Arbor. Dept. of Meteorology

and Oceanography

Mary A. Tiffany, John W. Winchester, and Ronald H. Loucks.

J Water Pollut Contr Federation, Vol 41, No 7, p 1319-1329, July 1969. 11 p, 10 fig, 5 tab, 13 ref. Contract No AT (11-1)-1705AEC).

Descriptors: *Water quality, *Great Lakes, *Trace elements, *Water pollution effects, Chlorides, Halogens, Algae, Water pollution sources, Water chemistry, Water analysis. Identifiers: *Bromine, *Iodine.

This study involves the determination of trace elements I, Br, and Cl in the Great Lakes, using neutron activation analysis of 90 water samples from Lake Superior and its tributary streams, Lake Michigan, southern Lake Huron, Lake St. Clair, western Lake Erie, and northern Lake Ontario. Possible pollution by bromine through an atmospheric route is of interest because of the combustion of leaded gasoline. Iodine deficiency in lake water may be related to thyroid disorders among marine fish which have become adapted to fresh water, and algae may offer competition for the available iodine. Chlorine is a noticeable contaminant except in Lake Superior. The Lake Superior streams appear to represent a good average of the atmospheric inputs of I, Br, and Cl. (Knapp-LISGS) W69-08562

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

5B. Sources of Pollution

DISPOSAL **SYSTEMS** NEAR **SEWAGE** SHORELINES.

For primary bibliographic entry see Field 05E.

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION).

For primary bibliographic entry see Field 05G. W69-08172

PLANT NUTRIENTS IN BASE FLOW OF STREAMS IN SOUTHWESTERN WISCONSIN,

Wisconsin Univ., Madison. Neal Minshall, M. Starr Nichols, and S. A. Witzel Grant V.I. 00556-04 HEW, Grant 14-01-0001-858 OWRR. Water Resources Res, Vol 5, No 3, pp 706-713, June 1969. 8 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Water chemistry, *Solutes, *Nutrients, *Base flow, *Wisconsin, Nitrogen compounds, Phosphorus compounds, Potassium compounds, Provenance, Leaching, Weathering, Ru-

Identifiers: Wisconsin River.

A 2-yr study was made of plant nutrients in the base flow of SW Wisconsin streams. The average base flow from 36 drainage areas covering a total of 643 sq mi was 4.9 in/yr. The annual nutrient losses in base flow were nitrogen, 1.1 lbs/acre; phosphorus, 0.10 lb/acre; and potassium, 1.8 lbs/acre. These losses were only 1/4 of those in the 1967 surface runoff from 0.01-acre plots at the Lancaster Experimental Farm and 3 Agricultural Research Service watersheds near Fennimore, Wisconsin. If precipitation of about 32 in. in a normal year, contains 10 lbs N/acre, fetrilizer applications 20 lbs N/acre, and subsurface or base flow an average of only 1 lb N/acre, then the other 29 lbs must be lost in surface runoff, retained for plant growth, or lost through denitrification. Total P lost per year, in the base flow was 0.1 lb/acre, which is approximately 2% of the amount applied and only 1/10 of that lost in the 10-7 period surface runoff. in the 1967 spring surface runoff from the Lancaster plots and Fennimore watersheds. Soluble K lost per year in the base flow was about 2 lbs/acre, about 10% of that applied and only 1/4 of that lost in the 1967 spring surface runoff. (Knapp-USGS) W69-08205

ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS,

Harvard School of Public Health, Boston, Mass. Kresge Center for Environmental Health For primary bibliographic entry see Field 05G W69-08212

STATUS OF RADIOACTIVE WASTE DISPOSAL

Vanderbilt Univ., Nashville, Tenn. Dept. of Sanitary and Water Resources Engineering. For primary bibliographic entry see Field 05E. W69-08214

ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2-METHYLBOR-NANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL ACTINOMYCETES, COMPOUND California Univ., Berkeley. Col. of Engineering; and California Univ., Berkeley. Dept. of Chemistry. For primary bibliographic entry see Field 05A.

AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN. Federal Water Pollution Control Administration,

Chicago, Ill. Great Lakes Region. For primary bibliographic entry see Field 05C W69-08220

SOME EFFECTS OF PESTICIDES ON MISSIS-SIPPI WATERS,

Mississippi Game and Fish Commission, Jackson. Fisheries Div.

For primary bibliographic entry see Field 05C. W69-08222

AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM,

Scripps Institution of Oceanography, La Jolla,

Caill.
T. R. Folsom, D. R. Young, and C. Sreekumaran.
Symp on Radioecology, Proc 2nd National Symp,
May 15-17, 1967, Ann Arbor, Mich, Nelson,
Daniel J and Evans, Francis C (eds). US Atomic
Energy Comm, Doc CONF 670503, pp 337-345. 3
fig, 2 tab, 17 ref, disc. Available from
Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Cesium, *Pacific Ocean, *Mathematical models, Migration, California, Oregon, Gamma rays, Spectrometers, Sea water.

Identifiers: *Thunnus germo, *Response rate, *Cesium-137, Muscle, Biological half-life, Accumulation ratio, Half-life, Sand, Scripps Institution of Oceanography.

A general form of mathematical framework has been adopted for connecting dynamic behavior and ultimate equilibrium in large oceanic fish, with possible convenience for testing hypotheses concerning migration rates and environmental factors. Formulas suggest that albacore may respond to changes in cesium rapidly and may accumulate relatively high levels. If albacore environment can be approximated by surface concentrations, biological half-life of their cesium appears to be less than 100 days. Ocean surface waters apparently are not dominant sources of cesium-137 experienced by albacore. Fallout cesium has been observed to be concentrated in surface-living fish classes, probably serving as food for tunas. Fraction of cesium entering tuna through the stomach is unknown. Large differences in concentration of cesium-137 between those typical in the Western Pacific and in surface waters near California suggested significant changes in radiocesium environment of certain albacore during migration. Available evidence suggested that large surface concentrations persisted to 200-meter depths, part of albacore's environment. Intense concentrations of fallout cesium persisting at depths near 100 meters were discovered. Organisms supporting tuna food-chain penetrate these layers daily. Albacore themselves may visit these layers frequently. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08271

STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC).

For primary bibliographic entry see Field 05G. W69-08316

MISCELLANEOUS PROVISIONS (UNLAWFUL DISCHARGE OF OIL IN CHARLESTON HAR-BOR).

For primary bibliographic entry see Field 05G. W69-08373

CHEMICAL CHANGES IN COOLING WATER TOWERS.

Central Electricity Generating Board, Barnet (England). Research and Development Dept. I. Davies.

Air and Water Pollution Int. Journal Vol 10, pp 853-863, Pergamon Press, 1966. 11 p, 4 tab, 11 ref.

Descriptors: *Cooling water, *Cooling tower, *Regression analysis, Evaporation, Dissolved oxygen, Circulation, Hardness (Water), Oxidation, Aeration, Water chemistry. Identifiers: Intake, Outlet, England, Make-up The chemical changes which occur in the water used in cooling towers have been studied using data from six English power stations. Simple concentration without chemical change occurs in many substances. The extent of concentration depending upon operating conditions. The carbon dioxide is scrubbed out of the water giving changes in hardness and pH. Ammonia is converted into nitrate. The water is aerated and part of the oxidizable impurities destroyed. Suspended solids settle out, but where sewage effluent is the source of make-up, some suspended solids are formed. (Sherman-Vanderbilt) W69-08402

POWER PLANT ANALYZING STEAM DISCHARGES,

Vanderbilt Univ., Nashville, Tenn.; and Johns Hop-

Vanderbilt Univ., Nashville, Tenn.; and Johns Hopkins Univ., Baltimore, Md. J. E. Edinger, and J. C. Geyer. Journal of the Sanitary Engineering Division, ASCE Vol 94, No SA4, Proc. Paper 6064, pp 611-623, Aug 1968. 23 p, 2 tab, 5 fig, 4 ref.

Descriptors: *Energy equation, *Heat transfer, *Diffusivity, *Thermal pollution, *Mathematical model, Heat, Thermodynamic behavior, Specific heat, Latent heat, Solar radiation, Conduction, Evaporation, Vapor pressure, Wind velocity, Flow rates, Cooling water, Heated water.
Identifiers: *Thermal exchange coefficient,

*Equilibrium temperature, *Temperature distribution, Analytic solution, Back radiation, Convection, Stefan-Boltzmann law, Atmospheric radiation, Reflected radiation, Field data, Heated discharge, Power generation.

The temperature distribution resulting from the advection, dispersion, and cooling of water from a steam electric power plant condenser is analyzed for a station located on a peninsula and discharging near the midpoint of a small narrow estuary. A theoretical temperature distribution equation is developed and used to predict the mean monthly temperatures to be expected within a mile of the discharge point for various levels of operation. Temperatures are related to an equilibrium temperature toward which water temperatures are driven by meteorological conditions. (Motz-Vanderbilt) W69-08411

FORECASTING HEAT LOSS IN PONDS AND **STREAMS**

Michigan Univ., Ann Arbor. Dept. of Environmen-

Michigan Only, Alin Aroot. Dept. of Environmental Health.
C. J. Velz, and J. J. Gannon.
Journal of Water Pollution Control Federation, Vol 32, No 4, p 392-417, Apr 1960. 26 p, 20 fig, 3 tab, 22 ref.

Descriptors: *Thermal pollution, *Heat loss, *Waste assimilative capacity, *Energy budget, Waste storage lagoon, Cooling water, Meteorologic variables, Hydrologic variables, Aquatic life, Water reuse, Steam power plants, Solar radiation, Air temperature, Wind velocity, Atmospheric vapor pressure, Drought flow, Statistical method, Proba-

Identifiers: Stream sanitation, Waste heat, Cooling pond, Evaporation loss, Convection loss, Radiation loss, Equilibrium water temperature.

This paper deals with methods of forecasting heat dissipation and the corresponding water temperature profile expected along the course of the receiving stream. The meteorologic and hydrologic variables involved are defined in statistical terms, making it possible to assign a probability of occurrence to any forecast of water temperature profile developed. Two practical applications are illustrated: (a) use of a wastewater storage lagoon as a cooling pond for reuse of the water and (b) use of river for dissipation of waste heat. This provides an advance in stream sanitation evaluation dealing with an increasing variety of waste heat problems, including site selection for industries and steam power plants. (Ross-Vanderbilt) W69-08415 SURFACE DISCHARGE OF HORIZONTAL

WARM-WATER JET, Yuan Jen, R. L. Wiegel, and Ismail Mobarek. USPHS Grant R6-5445. Journal of the Power Division, American Society of Civil Engineers, Vol 92, No P02, Apr 1966, p 1-30. 15 fig, 4 tab, 15 ref.

Descriptors: *Jets, *Mixing, *Power plants, Circulation, Cooling water, Testing, Flow, Thermal pollution, Model studies, Flow profiles, Diffusion.

Laboratory experiments were performed to study mixing of a heated (buoyant) jet of water discharged horizontally into a still ambient fluid at the surface. Ranges of jet temperature excess above the ambient fluid were 0 deg. to 35 deg. F; densimetric Froude numbers ranged from 18 to 180 and Reynolds numbers from 8300 to 21,000. Measured distributions were compared with an approximate theory based on earlier work on submerged jets. Necessary coefficients were evaluated in this manner. Surface temperatures along the centerline approximately adhere to the theory for about 100 diameters downstream. Beyond this point, mixing occurred more rapidly than predicted. Equations and data are presented. Though the surface temperature distribution on the centerline was found similar to that for submerged jets, more lateral mixing than vertical occurs to bring this about. Bottom slopes of the jet were found to vary between 12.5 and 18 percent. (Benedict-Vanderbilt) W69-08421

BOUYANT JETS INTO OR FLOWING AMBIENT TURBULENT STRATIFIED FLUIDS,

California Inst. of Tech., Pasadena.

Loh Nien Fan.

USPHS WP-00428 and WP-00680, FWPCA Grant WP-01256-01. W M Keck Laboratory of Hydraulics and Water Resources, Report No KH-R-15, Jun 1967. 196 p, 25 ref.

Descriptors: *Density stratification, *Jets, *Currents (Water), Hydraulics, Flow, Pressure drag, rents (Water), Hydraunes, Flow, Pressure drag, Thermal pollution, Diffusion, Flow characteristics, Flow profiles, Turbulence. Identifiers: *Bouyant jets, Entrainment, Concentration profiles, Marine sewage disposal.

Theoretical and experimental studies have been conducted for two cases: (1) a round bouyant jet in a stagnant environment with linear density stratification, and (2) a round bouyant jet in a uniform cross stream of homogeneous density. Use of the integral approach yielded a theoretical solution for the stagnant environment which proved satisfactory if a constant entrainment coefficient, alpha, of 0.082 was used. For a uniform cross stream, an integral analysis was carried out assuming an entrainment mechanism based on the vector difference of jet and ambient velocities. A gross drag term with a constant drag coefficient, Cd, was developed to express the effect of the unbalanced pressure field on the sides of the jet. Values for Cd and alpha were found by matching measured paths and dilution ratios to the theoretical model. Self-generated, rather than ambient, turbulence was found to control jet behavior up to about 250 diameters. Concentration profiles have also been measured and discussed, with similarity noted and maximum concentrations of 60-80 percent greater than center-line values observed. (Benedict-Vanderbilt) W69-08423

NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS,

California Inst. of Tech., Pasadena. California Inst. of Fech., Pasadena.
Loh-Nien Fan, and Norman H. Brooks.
FWPCA 16070 DGY. W M Keck Laboratory of
Hydraulics and Water Resources, California Institute of Technology, Report No. KH-R-18, Jan
1969. 94 p, 46 fig, 1 photo, 25 ref.

Descriptors: *Jets, *Density stratification, Diffusion, Mixing, Thermal stratification, Outlets, Waste dilution, Waste water disposal.

Identifiers: *Bouyant jets, *Forced plumes, Ocean

Theoretical solutions were obtained on four classes of turbulent bouyant jet problems, namely, (1) an inclined, round bouyant jet in a stagnant, uniform ambient fluid; (2) an inclined, round bouyant jet in a stagnant ambient fluid with linear density-stratification; (3) an inclined, slot bouyant jet in a stagnant, uniform ambient fluid; (4) an inclined, slot bouyant jet in a stagnant ambient fluid with linear density-stratification. This report is a summary of the numerical solutions on bouyant jets in stagnant environments carried out in connection with previous investigations by Fan, Fan and Brooks, and Brooks and Koh. Using the integral type of analysis, assuming similarity, predictions can be made for jet trajectory, widths, and dilution ratios, in a uniform or density-stratified environment without ambient currents. Numerical solutions have been presented in dimensionless form for a wide range of initial conditions including the effect of the initial angle of discharge. Problems with non-linear density profiles are not readily treated in generalized nondimensional form. Rather it is more feasible to make case by case calculations using dimensional variables. A program for such calculations for a round jet is available in a technical memorandum by Ditmars. These solutions are useful in the design of disposal systems for sewage effluent into the ocean or cooling water into a lake. W69-08424

WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG,

Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. David L. Sturges.

Water Resources Research, 1967, 3 (4): 1085-1089, Illus.

Descriptors: *Water quality, *Bogs, *Chemical properties, *Physical properties, *Coliforms, Groundwater, Perennial streams, Peat, Potable water, Fen, Wyoming. Identifiers: Seasonal changes in water quality.

Waters collected July through October 1965 at a Wyoming mountain bog were analyzed for potability and seasonal changes in calcium, magnesium, potassium, iron, and silica. Four locations were sampled: effluent stream, fissure locations in the bog, peat locations in the bog, and ground water. The color and turbidity of peat water greatly exceeded that at other locations and the maximum levels established by the U. S. Public Health Service for drinking water. The dissolved mineral content of all waters was very low, and the waters were of excellent chemical quality. All waters contained coliform organisms, probably of a nonfecal origin in peat and fissure water. The concentration of minerals in peat water remained constant through the sampling period. Mineral concentrations in ground water increased in September, when the water table was at a seasonal minimum, but decreased in October following water table recharge. Silica levels were higher than other ions at all locations; the highest levels were in peat water. W69-08455

GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, Forest Service (USDA), Laramie, Wyo. Rocky Mountain Forest and Range Experiment Station. David L. Sturges, and Robert E. Sundin.

Water Resources Research, 1968, 4 (1): 159-162,

Descriptors: *Fallout, *Radioisotopes, *Ground-water, *Perennial streams, *Snowpack, *Bogs, water, *Peren Fen, Wyoming.

Identifiers: Gross alpha radiation, Gross beta radiation, Radionuclide filtration.

Waters collected between July and October 1965 from four locations at a mountain bog were analyzed for radiologic content. The gross alpha and beta content of waters was less than 5 and 10 pc/liter, respectively. Gross beta activity of filterable solids in ground water collected above the bog reached 400 pc/gram when the water table was at a seasonal minimum, but on other dates and at bog and stream locations, the gross beta activity of filterable solids was less than 100 pc/gram. Radiation levels in waters from snow, overland flow, and stream sources were measured in May, June, or October 1965. Snow water activity was less than 25 pc/liter, but filterable solids had a maximum gross alpha and beta activity of 243 and 1348 pc/gram, respectively. Standing vegetation, litter, and moss on the bog surface screened radionuclides from snowmelt water. Radionuclide filtration on watersheds is significant from a public health standpoint. W69-08457

EFFECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER QUALITY, Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. E. A. Davis, P. A. Ingebo, and C. P. Pase. USDA Forest Serv Res Note RM-100, 4 p. 1968.

Descriptors: *Herbicides, *Water pollution, *Pesticide residues, *Brush control, Pesticides, Brush, Soil treatment, Watershed management, Forest management, Agricultural chemicals, Chemicals, Pesticide toxicity, Chaparral, Water quality, Wildlife, Aquatic life.
Identifiers: *Picloram, Woody plant control.

A soil application of picloram pellets (9.3 lb. acid equivalent per acre), on a 2-acre side drainage of a 46 acre chaparral watershed in central Arizona, resulted in the movement of detectable amounts of picloram into the stream water. The highest concentration of picloram found was 0.37 ppm; this concentration occurred after a 2.53-inch rainstorm 5 days after treatment. The extent of movement of picloram into the stream water was related to rainfall duration and amount. After a total of 40 inches of rain during a 16-month period, picloram was no longer detected in the stream water. Possible effects of watershed treatments with picloram on livestock, wildlife, aquatic organisms, and irrigated crops are considered. W69-08484

TREATING WASTES IN A WATER-SHORT AREA,

Texas Technological Coll., Lubbock.
For primary bibliographic entry see Field 05D. W69-08551

WATER POLLUTION CONTROL IN THE TEX-TILE INDUSTRY, American Textile Manufactures Inst., Charlotte, N.

C.; and Burlington Industries, Inc., Greensboro, N.

For primary bibliographic entry see Field 05G.

BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR,

Southeast Water Lab., Athens, Ga.; and Mississippi Air and Pollution Control Board, Jackson. R. D. Barbaro, B. J. Carroll, L. B. Tebo, and L. C.

J Water Pollut Contr Federation, Vol 41, No 7, p 1330-1339, July 1969. 10 p, 6 fig, 5 tab, 11 ref.

Descriptors: *Water quality, *Bacteria, *Coliforms, *Reservoirs, *Mississippi, *Recreation, Swimming, Boating, Water pollution sources, Water pollution effects

Identifiers: *Ross Barnett Reservoir, Jackson

Two 24-hr studies were conducted at the Ross Barnett Reservoir near Jackson, Mississippi. One was

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

during a period of high recreational activity (July 4, 1966) and the other during a period of relatively normal use (August 2, 1966). Ten reservoir stations, located in areas of most intense recreational use, were sampled for total coliform, fecal coliform, and fecal streptococci. No statistical difference was observed in total coliform counts, either between the days or among the stations on a given day; however, fecal coliform and fecal streptococci data showed significant variation, reflecting their suitability as indicator organisms. (Knapp-USGS) W69-08563

BIOLOGICAL CONCENTRATION OF PESTI-

CIDES BY ALGAE, North Texas State Univ., Denton. Dept. of Biology. For primary bibliographic entry see Field 05C. W69-08565

5C. Effects of Pollution

AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN.

Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region.

Fed Water Pollut Contr Admin, Great Lakes Reg Rep, Apr 1969. 107 p, 7 fig, 3 tab, 56 ref, 3 append.

Descriptors: *Water pollution, *Lake Superior, *Water quality control, *Water quality act, Waste treatment, Sewage treatment, Legislation, Water management (Applied).
Identifiers: *FWPCA.

Studies of the water quality and pollution problems of the Lake Superior basin made by FWPCA and cooperating agencies are summarized. The esthetic value of Lake Superior is of major importance. Increases in the range of 2-50 ppb of heavy metals such as copper, chromium, zinc, and cadmium will have lasting deleterious effects upon the lake. The exteme clarity and cold temperature of the waters of Lake Superior are a necessity to support its present ecology. Lake Superior is an oligotrophic lake, but nutrient values in some areas of the lake have been reported at levels approaching those commonly associated with nuisance algal growths, but other factors, such as temperature, are limiting. Municipal and industrial wastes with high concentrations of BOD has caused oxygen depletion in the St. Louis River, Duluth-Superior harbor, and Montreal River. The deposition of polluted dredgings contributes to the degradation in quality of Lake Superior. It is recommended that quality criteria reflect more appropriately the uniqueness of the lake. Secondary biological waste treatment should be provided by all municipalities. Existing combined sewers should be separated. (Knapp-USGS) W69-08220

MISSISSIPPI WATER RESOURCE CON-FERENCE - 1969. Mississippi State Univ., State College. Water Resources Research Inst.

For primary bibliographic entry see Field 02E.

SOME EFFECTS OF PESTICIDES ON MISSIS-SIPPI WATERS,

Mississippi Game and Fish Commission, Jackson. Fisheries Div. C. Rex Bingham.

Proc Miss State Univ Water Resources Res Inst Conf, Apr 8-9, 1969, pp 63-71, 1969. 9 p, 4 tab, 8

Descriptors: *Pesticides, *Water pollution sources. *Mississippi River, *Mississippi, Fishkill, Pesticide toxicity, DDT, Phosphothioate pesticides. Identifiers: Yazoo River (Miss)

Wolf Lake and Mossy Lake, in the Mississippi Delta, were sampled to study the amounts of pesticides in the water and sediment and the effect of pesticides on fish. DDT, TDE, and DDE were found on 15 of 15 sampling dates in Wolf Lake and on 11 of 15 in Mossy Lake. Toxaphene was found 10 of 15 days in Wolf Lake and 1 of 15 days in Mossy Lake. Methyl parathion was found in both lakes on 2 days. Pesticide concentrations were low to medium in February to early March, peaked in the spring, declined in the summer, and rose in autumn. Bluegills in Mossy Lake averaged 1.013 ppm DDT, and in Wolf Lake, 5.041 ppm. Largemouth Bass were planted in Wolf Lake but did not survive, possibly because of pesticides. (See W69-08221). (Knapp-USGS) W69-08222

INFLUENCE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF Zn-65 BY AN EXPERIMENTAL COMMUNITY,

Bureau of Commercial Fisheries, Beaufort, N. C.

Radiobiological Lab. T. Duke, J. Willis, T. Price, and K. Fischler Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche. Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 355-362. 3 fig, 1

Descriptors: *Zinc radioisotopes, *Environmental effects, Salinity, Temperature, Sea water, Oysters, Clams, Crabs, North Carolina, Sediments, Radioactivity, Marine animals, Estuarine environment, Fallout, Nuclear explosions, Biota, Spectrometers, Bacteria, Algae, Sands, Hydrogen ion concentration.

Identifiers: *Concentrations, Aequipecten irradians, Pivers Island (NC), Detector, Beaufort (NC), Crassostrea virginica, Mercenaria mercenaria, Panopeus herbstii.

Capacity of organisms to concentrate elements from seawater is affected by changes in environmental factors that alter the physiological condition of the organisms or the physical-chemical properties of elements. This knowledge is needed to evaluate potential hazards from radioactive pollution. Zinc-65 (Zn-65) enters the biochemical cycle of the estuarine environment in fallout from nuclear weapons and in effluent from nuclear reactors, occurring in measurable amounts in estuarine biota, sediments, and water. A polyfactorial approach is required to study the concentration of radioisotopes. Differences in salinity, temperature, pH, and zinc in seawater significantly affected the concentration of Zn-65 of a community of oysters, clams, mud crabs, and scallops, and their sediment substrate. A factorial analysis of variance showed no interactions among the environmental factors. High salinity and zinc concentration suppressed the concentration of Zn-65 in animals and sediment, whereas high temperature and pH HAD THE OP-POSITE EFFECT. Temporal variation in concentration factors for control animals and sediment was significant during the experiment. Such variation must be considered when reporting concentration factors for radionuclides in marine organisms. Data from this experiment represent a first step toward prediction of the fate of a radioisotope released into an estuary. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc) W69-08267

THE CONCENTRATION OF Zn-65 BY OYSTERS MAINTAINED IN THE DISCHARGE

CANAL OF A NUCLEAR POWER PLANT, Washington Univ., Seattle. Fisheries Research Inst., and Inter-American Tropical Tuna Commission, La Jolla, Calif.

Ernest O. Salo, and William L. Leet

Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 363-371, 4 fig, 1 tab, 3 ref,

Descriptors: *Zinc radioisotopes, *Oysters, *Nuclear powerplants, *Discharge (Water), Diets, Radioactive Absorption, wastes. Cobalt, Radioisotopes, California, Manganese, Cesium, Gamma rays, Background radiation, Indicators, Sedimentation, Temperature, Iron, Chromium.

Identifiers: *Concentration, Humboldt Bay (Calif), Maximum permissible body burden, Eureka, California, Half-life.

Zinc-65 (Zn-65) accumulation was measured in oysters bedded in discharge canal of Pacific Gas and Electric Company's Humboldt Bay Power Plant (nuclear-powered electric). Oysters of the 1962 and 1964 brood were reared on trays suspended from a raft, facilitating exposure to radioactive wastes discharged from the plant via this canal. Monthly average concentrations of Zn-65 in the waters of the discharge canal during the study ranged from 1.04 to 19.63 femtocuries/milliliter. Oysters were sampled as new groups were added, for over 400 days. Concentration of Zn-65 in the wet meats of the oysters varied from 0.99 to 174.0 picocuries/gram. Changes in concentrations of Zn-65 in oysters followed changes of Zn-65 in discharge waters. Concentration for the 1962 brood ranged from 5600 to 12,000, and from 8600 to 11,000 for the 1964 brood. Assuming constant pumping and filtering rates for the oysters, a factor for efficiency of absorption was determined to be less than 0.4% for the 1964 brood. Human protein diet of ovsters raised in canal would provide maximum concentration well within permissible body burden. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wisc) W69-08268

DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENIWETOK AND BIKINI ATOLS, AUGUST 1964, Washington Univ., Seattle. Coll. of Fisheries. A. D. Welander.

Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 346-354. 8 tab, 7 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

*Radioisotopes, *Distribution, Animals, Plants, Bottom sediments, Soils, Nuclear explosions, Cobalt radioisotopes, Cesium, Strontium radioisotopes, Manganese, Algae, Iron, Birds, Radioactivity, Invertebrates, Plankton, Fish, Sea water, Gamma rays, Radiochemical analysis, Tritium, Carbon radioisotopes, Biota, Clams, Fallout,

Pacific Ocean, Spectrometers.
Identifiers: *Eniwetok Atoll, Pacitic Ocean, spectrometers. Identifiers: *Eniwetok Atoll, *Bikini Atoll, Ruthenium-106, Antimony-125, Groundwater, Bismuth-207, Vertebrates, Plutonium-239, Rats, Zirconium-95-Niobium, Europium-155, Silver-110m, Cerium, Guettarda, Ipomoea, Pisonia, Pandanus, Muscle, Bone, Leaves, Shell, Rhodium-102.

Radionuclide analyses were made of more than 2000 samples of animals, plants, water, bottom sediments, and soils, collected at Eniwetok and Bikini Atolls, site of 59 nuclear tests between 1946 and 1958. Cobalt-60 was found in all samples but was dominant in the marine environment. Cesium-(Cs-137) and Strontium-90, however, predominated in terrestrial environments. All samples contained traces of manganese-54, although there were slightly larger amounts of this radionuclide in land plants and land invertebrates. Ruthenium-106 and antimony-125 were detected in significant amounts in groundwater and soil, with traces in animals and plants. Trace amounts of bismuth-207 were also found in most samples, and Cerium-144 usually in algae, soils and land plants. There were comparatively large amounts of iron-55 in a number of samples, especially in vertebrates.

Plutonium-239 was found in soil and in skins of rats and birds, in the few samples analyzed. Soils contained highest levels of radioactivity, followed by invertebrates, groundwater, shorebirds, plants, rats, plankton, algae, fish, bottom sediments, seawater, and seabirds. In land samples, Cs-137 proved to be best measure of distribution of radioactivity in bioenvironmental samples. Highest radioactivity was found in samples collected near test sites. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08269

RADIOZINC DECLINE IN STARRY FLOUN-DERS AFTER TEMPORARY SHUTDOWN OF HANFORD REACTORS,

Oregon State Univ., Corvallis. Dept. of Oceanog-

William C. Renfro and Charles Osterberg Symp on Radioecology, Proc 2nd National Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 372-379. 4 fig, 1 tab, 7 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Zinc radioisotopes, *Nuclear reactors, Columbia River, Washington, Estuaries, Radioactivity, Salinity, Gamma rays, Chromium, Sediments, Biota, Radioecology, Trophic level,

Spectrometers, Temperature.

Identifiers: *Platichthys stellatus, *Hanford (Wash), Ecological half-life, Effective half-life, Concentrations, Biological half-life, Neptunium-

Objectives were to relate zinc-65 (Zn-65) concentrations to trophic position, to examine variance in Zn-65 concentrations, and measure zinc turnover. Zn-65 concentrations and total zinc were measured in starry flounders collected periodically over a in starry flounders collected periodically over a one-year period from Alder Slough, a small arm of the Columbia River Estuary. Nuclear reactors at Hanford, Washington, which supply most of Zn-65 in the river were shut down for 45 days during this period, resulting in greatly reduced input of radioactivity to the study area, and specific activity (microcuries Zn-65 per gram total Zn) in flounders declined. Time required to reduce specific activity of Zn-65 by one-half, under conditions in which the flounders continued to obtain Zn-65 from their food web and water, is termed 'ecological half-life'. 'Ecological half-life' for Zn-65 in juvenile starry flounders was 139 days under the conditions prevailing in this study. Effective half-lives of Zn-65 in three flounders held in the laboratory were 56, 91, and 162 days, depending on initial concentration of Zn-65 in each test fish. Determinations of specific activities and 'ecological half-lives' would be of prime importance in case of acute radioactive contamination of an ecosystem. (See Vol 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08270

MEASUREMENTS OF BACKGROUND RADIA-

TION IN AQUATIC HABITATS IN ALASKA,
Dartmouth Coll., Hanover, N. H. Dept. of Biological Sciences; and Army Terrestrial Sciences
Center, Hanover, N. H.
G. E. Likens, and P. L. Johnson.

G. E. Likens, and P. L. Johnson. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 319-328. 3 fig, 2 tab, 21 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in

Descriptors: *Background radiation, *Aquatic habitats, *Alaska, Lakes, Rivers, Hot springs, Terrestrial habitats, Depth, Air, Sediments, Geologic formations, Arctic, Tundra, Scaling, Gravels, Mud, Sands, Shales, Bottom sediments, Cattails, Shales, Radioactivity, Interfaces, Organic matter. Uranium Gamma rays, Radioisotopes, radioisotopes, Radium radioisotopes, Potassium

radioisotopes, Spectrometers, Erosion, Fallout, Littoral, Algae, Biota, Genetics, Plankton.

Identifiers: Detector, Alaska, Hudeuc Lake, Pullin Lake, Graphite Lake, Old John Lake, Pingo Lake, Twelve Mile Lake, Brant Lake, Imikpuk Lake, North Meadow Lake, Gyttja, Duff, Ooze, Cobbles, Equisetum, Thorium-232, Yukon River, Nebesna River, Moose Creek, Arctic Circle Hot Springs, Radon, Central City (Colo), Mutation, Beta rays, Cosmic radiation, Steese Highway, Point Barrow.

High human whole-body counts of Eskimo population in northern Alaska introduced through fallout particles from nuclear weapons testing prompted study of background radiation in various Alaskan lakes. Measurements of ionizing radiation, made during 1965 in 9 lakes, 3 rivers, 1 hot springs area, and adjacent terrestrial substrates in Alaska, indicated that background radiation in these habitats varied greatly. The lakes were characterized by a small amount of ionizing radiation at mid-depths and increasing quantities near the air and sediment boundaries. Moreover, radioactivity of sediments near shore was 3.2 times greater as that near the center. This pattern of background radiation has been relatively consistent in natural lakes of diverse geographic areas; hence, a model for background radiation in freshwater lakes is proposed. Variations in this model were a function of local differences in geologic substrates and input of alloch'thonous materials. Radioactivity from sediments in Arctic tundra ponds was due to naturally occurring radionuclides with probable effects on biota. Authors speculate that organisms living in or near sublittoral sediments of lakes in recent times might undergo more frequent genetic changes than plankton or organisms in deepwater sediments. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08272

TRANSFER OF Zn-65 and Cr-51 THROUGH AN ESTUARINE FOOD CHAIN,

Bureau of Commercial Fisheries, Beaufort, N. C.

Radiobiological Lab.

Radiobiological Lab.
John P. Baptist, and Curtis W. Lewis.
Symp on Radioecology, Proc 2nd Natl Symp, May
15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J
and Evans, Francis C (eds). US Atomic Energy
Comm, Doc CONF 670503, pp 420-430. 5 fig, 5 tab, 28 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Zinc radioisotopes, *Chromium, *Radioactivity, *Estuarine environment, *Food chains, Phytoplankton, Brine shrimp, Fish, Trophic level, Sea water, Chlamydomonas, Temperature, Salinity, Gamma rays, Spectrometers, Zooplankton Gonads.

Identifiers: Mummichog, Micropogon undulatus, Eucinostomus, Half-life, Muscle, Gills, Spleen, Liver, Digestive tract and contents, Artemia, Fundulus heteroclitus, Radionuclide concentrations, Radionuclide uptake, Concentration processes.

Transfer of assimilated and unassimilated zinc-65 (Zn-65) and chromium-51 (Cr-51) was followed under controlled conditions through an experimental food chain, including phytoplankton, brine shrimp, post-larval fish, and mummichog. Food-chain transfer of Zn-65 and Cr-51 studies are needed because these radionuclides are released in relatively large amounts and accumulated by organisms in aquatic environments. Two separate but similar experiments were conducted measuring uptake of Zn-65 and Cr-51 from food; uptake from water was measured in conjunction with one of the two experiments. Both radionuclides were successively transferred through each level to the fourth trophic level, and concentrations generally declined up the food chain. Assimilated concentrations of Zn-65 were higher than those of Cr-51 in all trophic levels. Preliminary experiments indicated that organisms of each trophic level emptied their digestive tracts of radioactive contents with indicated the contents of the content within 48 hours when radioactive food was fol-lowed by non-radioactive food. Experimental data

were used to calculate theoretical maximum concentrations. Comparison of results from the food chain with results of experiments on uptake from seawater indicated that the food chain generally the more efficient pathway for uptake of Zn-65 and Cr-51 by all trophic levels except the second. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis)

THE PHOSPHORUS AND ZINC CYCLES AND

PRODUCTIVITY OF A SALT MARSH, Georgia Univ., Athens. Dept. of Zoology. L. R. Pomeroy, R. E. Johannes, E. P. Odum, and B.

Roffman.

Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 412-419. 3 fig, 1

Descriptors: *Zinc radioisotopes, *Phosphorus radioisotopes, *Salt marshes, *Cycling nutrients, Georgia, Sediments, Bacteria, Detritus, Estuaries, Plankton, Ecosystems, Sinks, Tracers, Crabs, Shrimp, Mullets, Fish, Algae. Identifiers: Duplin River (Ga), Spartina altemiflora, Organisms, Tursiops truncatus, Brevoortia tyrranus, Concentration processes.

By synthesizing results of experiments using phosphorus-32 (P-32) and zinc-65 (Zn-65) with earlier work in Georgia salt marshes, the cycles of the elements P and Zn are described quantitatively. Marsh grass and sediments dominate both cycles. The uppermost meter of sediments contains enough P to support Spartina production for 500 years and enough Zn for 5000 years. Spartina production removes P and Zn from subsurface (reduced) sediments and introduces them into the water (via bacterial utilization and subsequent utilization by detritus feeders) at a rate that replaces total water P in a month and total water Zn in a year. Significant part of P is exported from the marsh in organisms and detritus. The P and Zn in estuarine water are in equilibrium with plankton, bacteria, and surface (oxidized) sediments. Equilibrium strongly favors the sediments. Subsurface-sediment compartment of P and Zn is probably replaced by conversion of oxidized sediments to reduced sediments through creek meandering. Oxidized sediments are in equilibrium with water receiving inputs of P and Zn from land and sea. Transfer of P and Zn from deep sediments to water by Spartina explains the high concentration of these elements in the water. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis)

A COMPARISON BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA,

Comitato Nazionale per l'Energia Nucleare, La

Spezia (Italy). M. Bernhard, and A. Zattera.

M. Bernhard, and A. Zattera.
Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 389-398. 5 fig, 7 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche. microfiche.

Descriptors: *Zinc radioisotopes, *Marine algae, *Resins, Sea water, Physicochemical properties, Tracers, Distribution, Chelation, Detergents, Radioactivity, Amino acids. Identifiers: *Radionuclide uptake, *Phaeodac-

tylum tricornutum, EDTA, Ligurian Sea, European Mediterranean.

Organic substances occurring in seawater or introduced as contaminants, e.g., detergents, may chelate zinc and influence its availability to algae. Uptake of zinc-65 (Zn-65) AND STABLE ZINC BY A MARINE UNICELLULAR ALGA (Phaeodactylum tricornutum) and by a chelating

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects of Pollution

resin (Chelex-100) was studied in batch cultures during a certain time interval. In all experiments, the distribution pattern of Zn-65 and stable zinc between particulate matter (algae or chelating resin) and natural and artificial seawater medium differed. When Zn-65 was added as ionic zinc, proportionately much more radioactive zinc was taken up than stable zinc. However, when Zn-65 is added as Zn-EDTA-complex to a batch containing seawater and Chelex, stable zinc was initially taken up at a higher rate than was Zn-65. These preliminary results do not explain the difference in distribution of radioactive and stable zinc, but the data show that uptake rate of the stable isotope does not necessarily follow uptake rate of the radioactive isotope if the two are present in different physicalchemical states. This possibility must be taken into account in tracer studies and in predictions of the distribution of radioisotopes in environment based on specific isotope content approach. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08275

METABOLISM OF ZINC-65 IN EUPHAUSIIDS, Oregon State Univ., Corvallis; and Battelle-Northwest, Richland, Wash. Pacific Northwest

Scott W. Fowler, Lawrence F. Small, and John

Mark Dean.

Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 399-411. 8 fig, 34 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Zinc radioisotopes, *Marine animals, *Crustaceans, *Metabolism, *Temperature, Radioactivity, Guts, Oxygen, Tracers, Oregon, Gamma rays, Spectrometers, Columbia River, Weight, Surfaces, Cycling nutrients.

Identifiers: *Euphausia pacifica, *Thysanoessa spinifera, Exoskeleton, Eyes, Muscle, Body fluid, Autoradiographs, Detector, Half-life, Radionuclide uptake, Radionuclide concentration, Radionuclide elimination, Concentration processes.

To help understanding of biological role of zinc in marine food-chain organisms, authors studied uptake and retention of zinc-65 (Zn-65) by the pelagic crustaceans Euphausia pacifica and Thysanoessa spinifera. Experiments were performed at three temperatures (5, 10, and 15 deg C) and two concentrations of radiozinc (10 and 25 microcuries/liter). Weight-specific uptake and elimination of Zn-65 by dead (formalin-preserved) animals and by live animals (before molting) were statistically similar over all temperatures and Zn-65 concentrations tested. Molted exoskeletons averaged 41% of total live body activity. Largest fraction of radiozinc was associated with exoskeleton. Second largest fraction was associated with muscle and gut, with a smaller fraction in eyes and body fluid. Autoradiographs showed Zn-65 mainly located on exoskeleton and between muscle fibers, not intra-myofibrillar. Weight-specific activity varied inversely with weight, suggesting surface area phenomenon for uptake and loss. Relationships between Zn-65 uptake and dry weight, and between oxygen consumption and dry weight, varied by an order of magnitude. Authors conclude that Zn-65 uptake from water is neither directly nor indirectly related to euphausiid metabolism, which are potentially important in cycling of radioactivity from 'hot' pools in the sea. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08276

THE POTENTIAL IMPORTANCE OF SPAR-TINA ALTERNIFLORA IN CONVEYING ZINC MANGANESE, AND IRON INTO ESTUARINE FOOD CHAINS,

Bureau of Commercial Fisheries, Beaufort, N. C. Radiobiological Lab. Richard B. Williams, and Marianne B. Murdoch.

Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 431-439, 4 fig, 3 tab, 21 ref, disc. Available from Clearinghouse as CONF 670503 at \$3.00 in paper copy and \$0.65 in microfiche.

Descriptors: *Zinc radioisotopes, *Manganese, *Ron, *Estuarine environment, *Food chains, Radioactivity, Cycles, Salt marshes, North Carolina, Phytoplankton, Detritus, Radioisotopes, Sediment, Spectrometers, Atlantic Ocean, Standing crop, Productivity, New Jersey, Georgia, Delaware, Plant growth. Identifiers: *Spartina alterniflora, Beaufort (NC),

Sprout stage.

This study was conducted to increase insight into the flow of energy and materials in an estuarine ecosystem. Potential importance of cord grass, Spartina alterniflora, in conveying radioisotopes of zinc, manganese, and iron into estuarine food chains was evaluated on the basis of its annual production, its content of the three elements, and its annual cycle of growth and decay. Growth of Sparting was studied with harvest and other techniques, in salt marshes near Beaufort, North Carolina. Standing crop at maturity (in the fall) and annual production were estimated to average 545 and 650 grams dry weight per square meter, or 208 and 248 grams of carbon per square meter, respectively. Spartina production approached onethird the total phytoplankton net production of adjacent estuaries, and was thus potentially important in estuarine food chains. Zinc, manganese, and iron all had markedly higher concentrations in dead Spartina than in live, and averaged 22, 200, and 5000 parts/million (dry weight), respectively, in dead material. Unusually high iron content of the dead material suggested that Spartina detritus may be especially important in the movement of radioisotopes of iron from water and sediment into estuarine animal populations. (See Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08277

ALGAE: AMOUNTS OF DNA AND ORGANIC

CARBON IN SINGLE CELLS, California Univ., San Diego, La Jolla. Inst. of Marine Resources.

For primary bibliographic entry see Field 02K. W69-08278

LAKE TERMINOLOGY: WATER BLOOM.

Michigan State Univ., East Lansing. J. O. Veatch, and C. R. Humphrys. Bull Mich Agric Coll Exp Station, East Lansing, p 241, 1964. 1 fig.

*Eutrophication, Algae, Descriptors: Europinication, August, Dates, Color, Fishkill, Lakes, Odor, Toxicity, Water pollution effects, Water quality, Cattle.
Identifiers: *Definitions, *Water bloom, Toxic algae, Recreational use.

This lexicon of lake terminology defines a water bloom as: 'A prolific growth of plankton. A bloom of algae may be so dense that it imparts a greenish, yellowish, or brownish color to the water. The growth may be so concentrated in some parts of a lake that it interferes with swimming and boating. The algae not only imparts a disagreeable odor, but it may be a cause of fish mortality, and some species may be poisonous to cattle and ducks and a menace to drinking water supplies.' This entry includes an aerial photograph of an algal bloom concentrated in bay of a lake. (Eichhorn-Wis)

NITROGEN FIXATION IN SOME ANOXIC LACUSTRINE ENVIRONMENTS,
Florida Univ., Gainesville. Dept. of Environmental

Engineering. For primary bibliographic entry see Field 02H.

PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER SUPPLIES, New Hampshire Water Supply and Pollution Con-

trol Commission, Concord.

Terrence P. Frost. J New Hampshire Water Works Assoc, 7 p, April 1960, 6 ref.

Descriptors: *Algae control, *Water supply, *New Hampshire, Algae, Odor, Taste, Light Temperature, Nutrients, Copper sulfate, Stratification. Identifiers: *Corrective treatment, *Preventative treatment, Algae nuisance, Algae bloom, Algae growth, Water density, Convection currents, Algae treatment costs, Dinobryon, Concord (N H), Peanacook Lake (NH).

Author briefly reviews characteristics of algae and associated problems in New Hampshire water supplies, outlining preventative measures together with easiest and most economical controls used to date. Symptoms are undesirable taste and odor in water supplies, blooms in reservoirs, fouled pipes, and clogged filters. Occurrence of algae is influenced by light, temperature, convection currents, density stratification (spring and fall turnovers circulate bottom materials and algae, often initiating algal bloom), and nutrients which promote algal growth. Ideally, each waterworks should periodically examine samples microscopically to monitor algae species and apply preventative treatment before nuisance levels are reached. Algal control in most of New Hampshire's 76 public surface water supplies is practicable and in-expensive. Penacook Lake, supplying water for Concord, has a problem caused primarily by the species Dinobryon; this lake could be treated with copper sulfate to a depth of ten feet (3,380 acre feet) for \$340. Municipalities can obtain help from New Hampshire's Water Pollution Commission or Sanitary Engineering Division for identification of organisms and recommended dosages of copper sulfate. Use of chlorination and copper sulfate seem the best available means and only acceptable chemicals for treating their water supplies. (Ketelle-Wis) W69-08282

THE 'WORKING' OF THE MADISON LAKES, For primary bibliographic entry see Field 02H. W69-08283

BIOLOGICAL OXIDATION RATES IN MINE

ACID WATER REGIMES, Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources. For primary bibliographic entry see Field 05G. W69-08379

DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS, Rutgers - The State Univ., New Brunswick, N.J.

Robert C. Ahlert, Gabriel Biguria, and M.

Schlanger.
1969 ASME/AIChE Stream Pollution Abatement Conference - June 12, 1969 Rutgers University - The State of New Jersey, 30 p, 12 fig, 35 ref. OWRR Project A-019-NJ.

Descriptors: *Temperature, *Oxygen demand, Cooling water, Biological oxygen demand, Thermal pollution, Thermal stratification.

The authors have developed meanes of calculating temperature distributions downstream of a thermal outfall. This model is used to calculate the distribution of temperatures on a stream cross-section. Contributions to the oxygen dynamics of streams are temperature sensitive and vary substantially with respect to the local temperature distribution. In this paper, the effects of temperature on photosynthesis, reaeration and oxygen demand reactions are generated from a critical review of the literature. In turn, temperature dependencies have been combined with temperature distributions to assess the effect of distributed temperature on stream oxygen dynamics. Comparisons were made with a uniform temperature model. There is a significant difference between the two models and it is possible to conclude that temperature distribution must be taken into account in analysis of stream quality downstream of thermal outfall. (Ahlert-Rutgers) W69-08394

THERMAL EFFLUENT MAY CUT COST OF SHRIMP COCKTAIL.

Electrical World, p 30, May 27, 1968. 1 p.

Descriptors: *Heated water, *Shrimp, *Thermal pollution, Supply, Biology, Fish farming. Identifiers: Turkey Point Plant, Shrimp farming, Miami Univ. Inst. of Marine Sciences.

The constant supply of heated water in effluents from power plants is being used experimentally for shrimp farming. The project is at Turkey Point Plant in Florida. A survival rate of 90% is predicted in the seven ponds used (4-one quater acre ponds, 2-half acre ponds and one-one acre pond). Presently two quarter acre ponds are stocked with 6,000 four month old juvenile shrimp which have been fed hake, herring, alfalfa, corn, soybean meal and squid. In further aquaculture experiments pompano will be studied. (Sherman-Vanderbilt) W69-08401

THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS,

Vanderbilt Univ., Nashville, Tenn.

John E. Edinger, Derek K. Brady, and Willard L.

Journal of Water Pollution Control Federation, Vol 40, No 9, p 1632-1639, Sept 1968, 8 p, 4 fig, 3 ref.

Descriptors: *Thermal pollution, *Thermal power plant, Diurnal, Heat, Industry, Temperature, Wastewater, Cooling water. Identifiers: *Electric power generation.

Water temperatures in a body of water receiving waste heat from a thermal electric generating station vary with time due to changing plant loading and meteorological conditions. The time-averaged temperatures as well as the amplitude of the plant temperature variation decrease with distance from the discharge area and approach the water tem-peratures that would result from meteorological influences alone. As part of a continuing research on condenser water discharge, a study of the com-bined influence of varying plant loading and meteorological conditions on water temperatures has been made to test various time-varying prediction methods. Derivation of exponential equations used and a sample problem are included. (Ross-Vanderbilt) W69-08405

THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, Geological Survey, Washington, D. C. Water

Resources Div.

G. Earl Harbeck, Jr.

Geological Survey Circular 282, U.S. Depart. of the Interior, Washington, D.C., 1953. 6 p, 2 fig, 3

Descriptors: *Evaporation, *Water supply, *Thermal pollution, *Cooling ponds, Climatology, Hydrology, Energy-budget, Air temperature, Water temperature, Equilibrium, Stratification, Absorption, Storage, Latent heat, Reservoir. Identifiers: Lake Hefner, Southeastern Colorado.

A computational method is presented for estimating the possible saving in water resulting from the use of lakes or existing reservoirs instead of cooling towers for the dissipation of excess heat. This is a need in areas where water supplies are scarce. For the two reservoirs studied, annual water savings, using lakes instead of cooling towers, were found to be 45 - 50 percent. However, these figures do not apply to reservoirs built solely to dissipate excess heat, because the resulting evaporation rate (added surface and added heat) will be greater than the amount of water used in cooling towers. (Sherman-Vanderbilt)

W69-08406

AN INVESTIGATION INTO THE EFFECTS OF WARMED WATER FROM MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER.

Southampton Univ. (England); Southampton Harbour Board (England); and Central Electricity Generating Board, Southampton (England).

John P. M. Pannell, Albert E. Johnson, and John E. G. Raymont.

Proceedings of the Institution of Civil Engineers, pp 35-62, Oct 16, 1962. 28 p, 17 fig, 4 tab, 3 ref.

Descriptors: *Cooling water, Plankton, Salinity, Thermal pollution, Outfall chamber, Tidal cycles, Aquatic environment.

Identifiers: *Warmed water, warmed discharge, Cooling pond, Sea temperature, Limnoria. Teredo, Marchwood Power Station, Southampton water.

The new generating station at Southampton has resulted in a rise of about 50 F. in an area of Southampton water about 1/4 mile radius around the station outfall. The Fawley Refinery has had a similar effect on its own area. The tidal currents move the warm water for considerable distances in a layer below the cold fresh and above the cold salt water, the streams tending to keep to the southern shore of the estuary. The dispersal patterns are extremely complicated. Other than the wind, the maximum portion of the warned water from Marchwood Generating Station into Southampton water is caused by salinity variations and the physical position of the intake and outfall structures. Thermograph readings at the intake show that equilibrium has not yet been reached, because the temperature of the deeper water is still slowly rising. In similar estuaries with wide salinity variations it can be expected that dispersion of heat will be by mixing and not by cooling to atmosphere. With one exception, re-circulation has not taken place and the Marchwood Basin tends to act as a sump. The breeding period of Limnoria has been extended and the incidence of Teredo appears to have increased. There appears to have been no dimination in the total amount of plankton over the years. (Ross-Vanderbilt) W69-08408

ENVIRONMENTAL ASPECTS OF THERMAL

STATION DESIGN, Burns and Roe, Inc., Oradell, N. J.

R T. Richards.

Civil Engineering, pp 45-47, May 1968. 3 p, 3 fig.

Descriptors: *Thermal pollution, *Environmental effects, *Cooling tower, *Thermal power plants, *Power plant, Fisheries, Hydraulic models. Identifiers: U.S. Army Corps, Dry tower, Wet

Power companies are facing an increaxing problem of finding thermal plant sites acceptable from an environmental standpoint. The siting and design are complicated by a lack of firm and reasonable environmental criteria for determining site suitability. Public authorities need basic scientific information on the long-range effects of adding heat to streams. The interest and money of both private corporations and public agencies is available for this study now that thermal pollution has become recognized as a national problem. Cooling towers are suggested as a solution to the heat loading by these large plants. A conservative public, however, objects to their large size and cost. Another disadvantage is the production of fog. Other solutions are off-stream cooling ponds, dilution and dispersion of the warm water, and combinations of the above methods. (Sherman-Vanderbilt) W69-08409

THERMAL DISCHARGES,

Michigan Univ., Ann Arbor. School of Public Health

Ronald H. Laberge. Water and Sewage Works, p 536-540, Dec 1959. 5 p, 1 tab, 5 fig, 16 ref.

Descriptors: *Thermal pollution, *Thermal loading, Stream aquatic environment, Domestic wastes, Industrial wastes, Toxicity, Oxygen demand, Dissolved oxygen, Self-purification, Reaeration, Satu-

Identifiers: Aquatic Life Advisory Committee of the Ohio River Valley, Water Sanitation Commission. Trout.

The intention of this paper is to explain the effects of temperature on a stream. Thermal loadings to streams are rapidly becoming a critical problem in regard to maintaining a healthy lotic environment. Fish and aquatic life are discussed with reference to: the optimum, tolerable and critical temperature levels, chemical toxicity and oxygen requirements. The stream temperature is discussed in terms of depth, season and distance from discharge. It is described as an agent in relation to other environmental factors for which some data is given. The effects of temperature self-purification characteristics of a stream are shown by means of a hypothetical river situation. The relation of oxygen, deoxygenation and reaeration are quantitatively developed. A method is presented for computing the allowable thermal loading to meet required minimum dissolved oxygen levels. (Sherman-Vanderbilt) W69-08413

ESTIMATING FORCED EVAPORATION FROM COOLING PONDS,

Geological Survey, Denver, Colo. G. Earl Harbeck, Jr.

Journal of the Power Division, Proceedings of the American Society of Civil Engineers, Vol 90, No PO3, pp 1-9, Oct 1964. 10 p, 2 fig, 5 ref.

Descriptors: *Thermal pollution, *Water management, *Power plants, Energy budget, Mass transfer, Meteorological data, Reservoir. Identifiers: Natural inflow, Energy storage, Water surface, Cooling pond, Bowen ratio, Wind profile.

Based on energy-balance concepts, a graph has been developed to permit the estimation of the increase in evaporation, or forced evaporation, resulting from the addition of heat by a power plant to a cooling pond or reservoir. In order to use the graph, the data needed are the amount of heat added by the plant, the air temperature and the wind speed measured at the nearest weather station. The percentage of heat that is added and that is utilized in measuring evaporation increased with both wind speed and temperature. Simplifying assumptions and approximations have been made. (Sherman-Vanderbilt) W69-08414

RECIRCULATION OF COOLING WATER IN RIVERS AND CANALS,

Iowa Univ., Iowa City. Inst. of Hydraulic Research. Gaza L. Bata.

Journal of the Hydraulics Division of the American Society of Civil Engineers, Vol 83, No HY3, p 1265-1 thru p 1265-26, June, 1957. 26 p, 17 fig, 12

Descriptors: *Design criteria, *Recirculated water, Coolants, Diversion, Flow, Froude number, Stratification, Upstream, Downstream, Rivers,

Identifiers: Intake, Outlet, Warm wedge, Interface.

The recirculation of water after it has been used as a coolant in thermoelectric plants and returned to the river or canal from which it was originally drawn is of great importance to the economy of operation of such plants. Among the many factors that affect the amount of recirculation, the most important ones are the channel and discharge, the

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

distance between intake and outlet of the flow diverted for cooling, the degree of heating of the diverted water, and the relative amount of diversion. three major conclusions concerning the recirculation of cooling water at a stream plant may be drawn: (1) the three zones of flow are not influenced by one another; the critical depths are established at the end sections of the upstream and middle zones; (2) in the three-dimensional case with side intake and outlet, the amount of recirculation is governed in magnitude by the depths immediately upstream and downstream from the side intake; and (3) the amount of recirculation for the two-dimensional case of a bottom-slot intake is much less than that for a side intake. (Sherman-Vanderbilt) W69-08416

SELECTIVE WITHDRAWAL FROM DENSITY -STRATIFIED RESERVOIRS,

California Inst. of Tech., Pasadena. Norman H. Brooks, and Robert C. Y. Koh. Journal of the Hydraulics Division, ASCE Vol 95, No HY4, p 1369-1400, July 1969. 2 p, 12 fig, 28

*Stratified *Reservoirs, Descriptors: *Withdrawal, Fluid flow, Hydraulics, Outlets, Selectivity, Water quality.
Identifiers: Laboratory tests, Mathematics.

Analyses and experiments for selective withdrawal flows from linearly stratified fluids, including inviscid, viscous, and turbulent cases are presented A review of discrete layer systems is also included These thin jet-like flows have been observed both in the laboratory and in large reservoirs, and boundary layer assumptions appear to be justified. For turbulent withdrawal flows away from immediate vicinity of the outlet, it is hypothesized that Koh's viscous diffusive experiments and analysis can be applied by replacing the kinematic viscosity, v, and the molecular diffusivity, D, by the vertical eddy diffusivity, Em. For self-generated turbulence, it is predicted that the proper characteristic length is a= (q/ (sq. rt. of (g (epsilon))) to the 1/2 power, in which q= the unit discharge and (epsilon)= (1/po) dp/dy. Equations and a graph are given for predicting the thickness of the withdrawal layer under various flow assumptions from real reservoirs. Transients are also presented. The results of this paper may be used in predicting the performance of a multioutlet system in dams for water quality control by selective withdrawal. (Hsieh-Vanderbilt) W69-08419

CONDITIONS - FOR COEXISTENCE OF AQUATIC COMMUNITIES WITH THE PANDING NUCLEAR POWER INDUSTRY, WITH THE EX-

Bureau of Commercial Fisheries, Washington, D . Resource Management Branch.

William S. Davis. Nuclear Safety, Vol 10, No 4, p 292-299, July-August 1969. 8 p, 15 ref.

Descriptors: *Thermal pollution, *Radioactive wastes, *Nuclear power plants, *Aquatic environ-ment, Waste-discharge, Water quality control, Water pollution effects, Heavy metals, Chemical wastes, Absorption, Retention, Distribution, Copper, Bioassay, Diversion.

Identifiers: Contaminated zone, Intrastate, National Technical Advisory Committee.

Communities of aquatic plants and animals cannot indefinitely withstand indiscriminate use of their environment for disposal of the thermal, radioactive, and chemical waste of nuclear and fossilfueled thermoelectric production. The diversion of large quantities of water for use in cooling condensers may also be harmful. Although developing water-quality standards will limit introduction of such wastes into interstate and coastal waters, they will not regulate specifically the amount of water taken into power plants for cooling. New regions of temperature, radioactivity, and chemistry will be

established in many interstate and coastal waters when the limits imposed by water-quality standards and licensing authorities are attained nationwide. The efforts of aquatic biologists and engineers must be complementary to ensure wide use of the water resources of the nation. (Sherman-Vanderbilt) W69-08420

THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS,

Army Terrestrial Sciences Center, Hanover, N. J. S. L. Dingman, W. F. Weeks, and Y. C. Yen. Water Resource Research, Vol 4, No 2, pp 349-362, Apr 1968. 14 p, 7 fig, 1 tab, 2 ref.

Descriptors: *Thermal pollution, *Ice, *Rivers, *Navigation, Differential equation, Hydrometric variables, Meteorologic variables, Energy budget. Identifiers: *Ice-free reaches, St. Lawrence Seaway, Mississippi River, Minneapolis - St. Paul

An attempt is made to calculate the length of the ice-free reach that develops during the winter below a thermal pollution site on a river. A differential equation for the steady-state heat balance of a volume element of a river is developed. The computer program makes possible more universally applicable estimations. The differential equation for the steady-state heat balance of a volume element of a river leads to the expression x= Cx times the integral from Two to Twx of dTw over Q*, where x is distance downstream from the pollution site to the cross section where the water temperature equals Twx, Two is water temperature at x equals zero, Q* is rate of heat loss from the water surface, and Cx is a constant that includes flow velocity and depth. The value of x at Twx equals 0 deg C is taken as the length of the ice-free reach. Q* is the sum of heat losses due to evaporation, convection, long- and short-wave radiation, and other processes, each of which is evaluated by an empirical or theoretical expression. The two principal limitations in accurately calculating downstream temperature changes are related to difficulties in evaluating the degree of lateral mixing in natural rivers and the convective and evaporative heat losses under unstable atmospheric conditions. Observations of lengths of ice-free reaches on the Mississippi River are in good agreement with the calculated values. Significant portions of the St. Lawrence Seaway can be kept ice-free by the installation of nuclear reactors at ap-propriate locations. (Shin-Vanderbilt) W69-08422

DETERMINATION OF FEEDING CHRONOLO-GY IN FISHES,

Marquette Univ., Milwaukee, Wis. Dept of Biolo-

Rezneat M. Darnell, and Richard R. Meierotto. Transactions of the American Fisheries Society, Vol 91, No 3, p 313-320, July 1962. 2 fig, 4 tab, 20

Descriptors: *Bullheads, *Fish food organisms, *Food habits, *Methodology, Crustaceans, Detritus, Insects

Identifiers: *Digestive rates, *Ictalurus melas, Hyalella azteca, Stomach analyses.

A method is presented for determining the 24-hour chronology of feeding intensity of fishes, based on periodic stomach sampling and digestive rate studies involving a standard food item, Hyalella azteca. The method is applied to a natural population of young black bullheads. Based on 3-hour collection intervals, two feeding peaks were found: a major peak occurring just before dawn and a secondary peak occurring shortly before dark. Data on food habits, expressed as percentage of total volume are: amphipods 54.1, insect larvae 19.2, organic detritus 15.1, insect adults 4.5, algae and fungi 3.4, juvenile crayfish 2.8. Tabular data include results of stomach analyses and calculated food volumes for 3-hour collection periods. (Voigt-W69-08514

FOOD HABITS OF THE YELLOW BASS, ROC-CUS MISSISSIPPIENSIS, CLEAR LAKE, IOWA, **SUMMER 1962.**

Iowa Cooperative Fisheries Research Unit, Ames. Rudy Kraus.

Iowa Acad of Sci, Vol 70, pp 209-215, 1963. 3 fig, 2 tab, 6 ref.

Descriptors: *Fish food organisms, *Food habits, *Iowa, *Yellow bass, Amphipoda, Crustaceans, Insects, Zooplankton, Eutrophication.

Identifiers: *Clear Lake, *Diurnal periodicity, Iowa, Entomostraca, Immature insects, Odonata.

Yellow bass are a dominant member of the fish fauna of eutrophic Clear Lake. Stomach analyses of fish collected by gill netting indicated that young yellow bass fed on the following (percentage frequency of occurrence): Copepoda 87.6, Cladocera 50.7, Chronomidae 30.7, Hyalella 27.6. In terms of bulk (volume, estimated but not measured) food organisms appeared in the same order of importance. Similar analysis of stomachs of older yellow bass yielded: immature insects 81, Cladocera 43, Hyalella 12, and Copepoda 10% frequency of occurrence. Adult insects and small fish were of incidental importance. Among immature insects, Diptera, mostly chironomids, were most important (71%). Comparison with previous studies (two, four and five years earlier) indicates increasing importance of immature insects, especially chironomid larvae, and decreasing importance of crustacean zooplankton. Yellow bass showed a diurnal feeding periodicity, with peaks observed at 6 p.m. and 8 a.m. Fish activity, as inferred from gill-net catches indicated greatest activity between 6 p.m. and 4 a.m. (Voigtlander-Wis) W69-08515

EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-WATER FISHES, Oregon State Univ., Corvallis. Pacific Cooperative

Water Pollution and Fisheries Research Labs. Robert C. Davison, Wilbur P. Breese, Charles E. Warren, and Peter Doudoroff.

Sewage and Industrial Wastes, Vol 31, No 8, pp 950-966, August 1959. 2 fig, 4 tab, 17 ref.

Descriptors: *Cold water fish, *Dissolved oxygen, *Oxygen requirements, Laboratory Tests, Salmon, Sculpins, Sulfite liquors.

Identifiers: *Coho salmon, Feeding studies, Oncorhynchus kisutch, Cottus perplexus.

Dissolved oxygen requirements of juvenile coho salmon and sculpin were determined under experimental conditions of flowing water and controlled temperature. Experiments performed in fall showed no appreciable changes in minimum oxygen concentrations (1.1-2.1 milligrams/liter) tolerated for one day between 12-20 deg C, but tolerance was reduced as upper thermal limit was approached (25 deg C). In summer and fall, at constant temperature (20 deg C), salmon tolerated for one day oxygen concentrations below 2 millione day oxygen concentrations below 2 inin-grams/liter but succumbed at 1 milligrams/liter. Feeding experiments at 18 deg C and oxygen con-centrations of 2, 2.9, and 9 milligrams/liter in-dicated a weight loss due to sluggishness and poor feeding at 2 milligrams/liter oxygen, and gains in weight of 28 and 42% at 2.9 and 9 milligrams/liter, respectively. Addition of 1200 milligrams/liter sulfite liquor had no appreciable effect on oxygen requirements, but authors state results are not conclusive. Tests on sculpin indicate no difference in oxygen requirements, but capacity for acclimatization may be less. Figures include diagram of test apparatus. Tabular data include results of variable oxygen concentrations, feeding studies and sulfite liquor tests. (Voigtlander-Wis) W69-08516

EUTROPHICATION,

J. Foehrenbach. Journal WPCF, Vol 41, No 6, pp 1029-1036, June

1969. 53 ref.

Descriptors: *Eutrophication, *Reviews, Documentation, Bibliographies, Phosphorus compounds, Nitrogen compounds, Bioindicators, Productivity, Waste treatment, Water pollution effects. Water pollution sources, Cycling nutrients, Cost comparisons, Economics, Algae, Algal control, Algicides, Sediments, Dissolved oxygen, Oxygen demand, Cyanophyta, Diatoms, Sampling, Lake Michigan.

Identifiers: Cultural eutrophication, Species diver-

sity, Chemical precipitation.

Author reviews 53 studies contributed to the eutrophication literature during the period 1966-1968. Subject coverage, with number of literature citations per subject in parentheses, are: use of fertilized water to increase biological production (8); identification of nutrients (6); oxygen kinetics (3); algal control (2); sources of nitrogen and phosphorus (4); role of sediments (2); results of human cultural activities (2); effects of pollutional load (2); cyanophyte blooms and decrease in algal species diversity (2); eutrophication indicators in Lake Michigan (2); sampling and diatom-indica-tors (2); nutrients, their critical levels and cycling (4); advanced waste treatment techniques with cost estimates (7); chemical treatment for nutrient removal with cost estimates (7). (Eichhorn-Wis)

INFLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN METABOLISM OF BLUEGILL SUNFISH,

Indiana Univ., Bloomington. Dept. of Zoology.

Shelby D. Gerking.

Physiological Zoology, Vol XXVIII, No 4, p 267-282, October 1955. 3 fig, 5 tab, 46 ref, disc.

Descriptors: *Feeding rates, *Sunfishes, Efficiencies, Nitrogen, Metabolism.

Identifiers: *Bluegill, *Lepomis macrochirus, *Protein utilization, Nitrogen consumption, Protein utilization, Utilization efficiencies.

One of the most important aspects of fish production is the relationship between a population and its food supply, and the details of utilization of that food supply. Bluegills were fed mealworms (Tenebrio) at five rates, equal to 1.5, 2, 3, and 4 times the metabolic rate, equalling from 1 to 3.5% of the original (beginning) body-weights per day. Food items and fish were analyzed for protein and non-protein nitrogen, fat and ash. Efficiency of protein absorption was not affected by different feeding rates (range 95.8-97.0%). Chemical composition of fish was affected by feeding rate with dry substance (oven-dry weight), with fat content increasing while ash and total nitrogen diminished as feeding rates increased. Percentage increases over the entire range of feeding rates for dry weight, fat and total nitrogen were: dry weight, 9.8-63.4; fat, 140-383; total nitrogen, 0.0-38.4. Nitrogen retention increased with feeding rate, and efficiency of protein utilization increased asymptotically with feeding rate. Tabular data include analyses of chemical composition of food and fish, estimates of ash, fat, and total nitrogen content of fish, and analyses of nitrogen consumption and retention. (Voightlander-Wis) W69-08520

THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,

Oregon State Univ., Corvallis. Dept. of Oceanog

Ford A. Cross, John M. Dean, and Charles L.

Osterberg.

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich. Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 450-461. 4 fig, 4 tab, 48 ref, disc.

*Radioisotopes, *Amphipoda. Descriptors: *Benthic fauna, *Marine animals, *Temperature, *Sediments, Cycles, Zinc radioisotopes, Oregon, *Sediments, Cycles, Zinc radioisotopes, Oregon, Sea water, Radioactivity, Gamma rays, Spectrometers, Tagging, Brine shrimp, Trophic level, Feeding rates, Washington.

Identifiers: *Radionuclide uptake, Anonyx, Ceri-

um-144, Chromium-51, Scandium-46, Biological half-life, Species, Hanford Atomic Operation, Washington, Effective half-life, Molting, Ex-

Laboratory studies were conducted to determine effects of temperature, feeding, and presence of sediments on behavior of zinc-65 (Zn-65) in a gammarid amphipod (Anonyx sp) captured off the Oregon coast. In feeding experiments, cerium-144, (Ce-144), scandium-46 (Sc-46), and chromium-51 (Cr-51) were used in addition to Zn-65. Accumulation and elimination rates of Zn-65 were temperature dependent, although the effect appeared minimal within this organism's seasonal temperature range. Individual differences in Zn-65 accumulation rates for amphipods of similar size had a mean standard deviation range of 14-19%. Elimination rates of Zn-65 were increased in presence of sediment and were significantly greater in feeding than in nonfeeding amphipods. Anonyx, which fed on adult Artemia labeled simultaneously with Zn-65, Ce-144, Sc-46, and Cr-51, retained 55% of the Zn-65 and less than 10% of the Ce-144 and Sc-46. Transfer of Cr-51 was not measurable. Zn-65 loss during molting depended upon whether the zinc had been accumulated from food or water. When uptake was from water, approximately 20% of the Zn-65 body burden was lost with the cast ex-oskeleton, whereas only 2.0% was lost when Zn-65 was accumulated from food. The potential role of Anonyx in radioactivity cycling in marine environments is discussed. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08522

ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE ZOOPLANKTON,

North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.

Edward J. Kuenzler.

Edward J. Kuenzler.

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich. Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 462-473. 2 fig, 6 tab, 21 ref, disc.

Descriptors: *Marine animals, *Zooplankton, *Iodine radioisotopes, *Cobalt radioisotopes, *Iron, *Zinc radioisotopes, Fallout, Nuclear explosions, Tracers, Copepods, Ecology, Radioactivity, Pacific Ocean, Indian Ocean, Atlantic Ocean, Sea water, Temperature, Resins, Ion exchange, Gamma

Identifiers: *Elimination rates, Pyrosoma verticillatum, Cyclosalpa pinnata, Sagitta enflata, Sagitta hexaptera, Euphausiids, Pteropods, Chaetognaths, Heteropod, Neocalanus gracilis, Pleuromanna xiphias, Pleuromamma abominalis, Candacia ethiopica, Euchirella, Euchaeta marina, Salpa cylindrica, Salpa fusiformis, Thysanopoda tricuspidata, Crab megalops, Cavolinia inflexa, Euclio pyramidata, Cuvierina columnella, Carinaria lamarcki, Scaeurgus unicirrhus, Beroe ovata, Scaler, Scintillation crystal, Analyzer, Comparative physiology, Biogeochemistry.

Measurement of elemental elimination rates were made using zooplankton labeled by fallout from nuclear test and with tracers. Rates depended on element, species, and time since labeling. In experiments performed soon after labeling, copepods had elimination rates of 1-6%/hour for iodine (I), 4-6%/hour for cobalt (Co), and about 1%/hour for zinc (Zn), Pyrosoma, about 1%/hour for I and Zn, and 2-3%/hour for Co and iron (Fe); salpidae, 8-19%/hour for Co; Sagitta, 22%/hour for I, 11%/hour for Co, and 3%/hour for Zn; euphausiids. 1%/hour for I and Co, and 5%/hour for Zn; pteropods, 5-6%/hour for I and Fe, and 1-3%/hour for Co and Zn. Filtration and ion-exchange techniques indicated the physical and chemical form of eliminated products: most iodine was probably anionic but copepods eliminated some cationic; much iron was particulate; significant amounts were soluble anionic or non-exchangeable; some cobalt was particulate; most was cationic, zinc was frequently particulate, but also exchangeable and non-exchangeable. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08523

SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM FLUITANS AND S NATANS, Texas A and M Univ., College Station; and Kansas

Univ., Lawrence. John E. Simek, J. A. Davis, C. E. Day III, and

Ernest E. Angino.

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich. Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 505-508. 2 fig, 5 ref. disc.

Descriptors: *Radioisotopes, *Algae, *Sorption, Absorption, Gulf of Mexico, Atlantic Ocean, Radioactivity, Gamma rays, Potassium rays, 1 Cesium, Radioactivity, Gamma radioisotopes, Manganese, Radium radioisotopes, Waniganese, Cestum, Radium radioisotopes, Uranium radioisotopes. Identifiers: *Sargassum fluitans, *Sargassum natans, Seaweed, Zirconium-95-niobium-95, Pre-

bomb material, Ruthenium-106-rhodium-106, Ruthenium-103-rhodium-103, Cerium-144-

praseodymium-144.

Sargassum natans and S fluitans, free-floating marine algae, can effectively concentrate certain radionuclides. In the evaluation of radionuclides found associated with these two species, an answer was sought as to the manner of this association. Floating samples were collected from the Gulf of Mexico and from North Atlantic areas. An analysis of Sargassum material collected prior to 1940 (prebomb) provided a positive means of comparing the activity added to the spectrum by nuclear activity. Tests utilizing acid, base, and neutral washes, were devised to determine whether adsorption or absorption was the major nuclide-plant association. Washington with uncontaminated, doubly distilled water, resulted in removal of only small amounts of potassium-40 (K-40), probably due simply to a washing out of sea salts. Separate, short term (up to I hour) washed of samples with slightly acidic and basic solution failed to indicate any activity other than that of K-40. However, acid and base washes for 24 hours produced definite evidence of activity; over this period, breakdown of the plant material became obvious. Results suggest that radionuclides in question are absorbed, or metabolically fixed, rather than adsorbed to Sargassum natans and S fluitans. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis)

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE ANCHOVY (ANCHOA LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD HERRING ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA FLABELLUM LAMOUROUX), Puerto Rico Nuclear Center, Mayaguez.

Puerto Rico Nuclear Center, Mayaguez.
Robert Y. Ting, and V. Roman de Vega.
Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich. Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 527-534. 5 fig, 15 ref, disc.

Descriptors: *Algae, *Herrings, Copper, Iron, Cobalt, Manganese, Atlantic Ocean, Puerto Rico, Spectroscopy, Distribution, Calcium, Trophic Spectroscopy, Di levels, Food webs.

Identifiers: *Trace elements, *Anchoa lam-protaenia, *Opisthonema oglimun, Udotea flabel-lum, Zinc, Nickel, Puerto Rico, La Parguera, Joyu-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects of Pollution

Qualitative and quantitative information on stable elements contained in organisms and their environment is essential in predicting distribution patterns of artificially introduced radioisotopes of the same elements. Little is known of the distribution and variability of various elements and their radioisotopes within species of marine organisms sampled from the same area at a given time. To study their transfer through food webs and to evaluate concentration factors at each level, trace amounts of the elements copper, iron, and zinc, were determined in longnose anchovy (Anchoa lamprotaenia Hildebrand) and in alga (Udotea flabellum Lamouroux) from La Parguera and Joyuda, Puerto Rico. Levels of cobalt, copper, iron, manganese, nickel, and zinc in Atlantic thread herring (Opisthonema oglinum LaSueur) from La Parguera, were also determined. Analyses were accomplished with atomic absorption spectroscopy. Concentrations of the elements in individuals of the same species sampled within the same locality at the same time did not approximate normal distribution; however, distributions of the log-transformed concentrations closely approximated a normal curve in most cases. With expanded nuclear technology, radioisotopes in the environment may approach levels for which knowledge of the dis tribution patterns of these materials will be of primary importance. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08525

PHOSPHORUS TURNOVER BY CORAL REEF

Georgia Univ., Athens. Dept. of Zoology; and North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.

L. R. Pomeroy, and E. J. Kuenzler. Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, pp 474-482. 1 fig, 3 tab, 34 ref, disc.

Descriptors: *Phosphorus, *Coral, *Reefs, *Marine animals, Fish, Ecosystems, Cycling nutrients, Temperature, Light quality, Chlorophyll, Zooplankton, Algae, Polychaeta, Crustacea, Mollusca, Echinodermata, Pacific Ocean.

Identifiers: Eniwetok Atoll, Turnover time, Tridacna crocea, Woods Hole Oceanographic Institution, Acropora hyacinthus, Pocillopora eydouxi, Porites lobata, Leptastrea purpurea, Fungia fungites, Zooxanthellae, Acanthurus triostegus, Conus

Coral reefs are particularly interesting ecosystems in which to study nutrient cycling, because of their great diversity of life and their high rates of organic production in a nutrient-depleted environment. Phosphorus (P) content and elimination rates were measured for dominant reef animals at Eniwetok Atoll, and flux of P through the organisms was expressed as turnover time. Herbivorous fishes appear to receive in their diet just enough P for growth and reproduction; this is reflected in a somewhat lower excretion rate and longer turnover time than would be predicted for organisms of their size, particularly the juveniles. Carnivorous animals and deposit feeders receive excess P in their diet, and their turnover time does not differ from ecosystems with a more abundant P supply. Of 5 species of reef corals examined, 4 showed a very long turnover time and little flux of P to the environment. Tridacna crocea showed a typical turnover time for a mollusc of its size, but seemed to lose most P via incorporation in living zooxanthellae, which are subsequently lost. This sampling of the flux of P is necessarily incomplete although organisms known to be dominant have been selected for study. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis)

ACCUMULATION OF **FALLOUT** RADIOISOTOPES BY BIVALVE MOLLUSCS FROM THE LOWER TRENT AND NEUSE RIVERS, Bureau of Commercial Fisheries, Beaufort, N. C.

Radiobiological Lab. Douglas A. Wolfe, and Claire L. Schelske. Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 493-504. 5 fig, 2 tab, 24 ref, disc.

Descriptors: *Fallout, *Radioisotopes, *Mollusks, *North Carolina, Gamma rays, Radioactivity, Spectrometers, Salinity, Cesium, Manganese, Zinc radioisotopes, Nuclear explosions, Cycling nutrients, Strontium radioisotopes, Aquatic populations, Estuarine environment, Sea water, Trace elements, Fresh water, Rainfall, Potassium radioisotopes, Cobalt radioisotopes, Radium radioisotopes.
Identifiers: *Trent River, *Neuse River (N C), El-

liptio complanatus, Rangia cuneata, Polymesoda caroliniana, Ruthenium-106, Ruthenium-103, Cerium-144, Cerium-141, Zirconium-95-niobium-95, Barium-140-lanthanum-140, Chinese nuclear tests, Half-life, Biological concentrators, Anodonta cataracta, Anodonta imbecillis, Lampsilis cariosa, leucophaeta, Macoma phenax, Congeria Radionuclide accumulation, Biogeochemistry.

Bivalve molluscs are useful indicators of distribution of fallout radioisotopes in an aquatic environment. Three species of filter-feeding molluscs, Elliptio complanatus, Rangia cuneata, and Polymesoda caroliniana, were collected from stations in the Trent and Neuse Rivers in Eastern North Carolina at intervals for more than a year Soft tissues of each species were ashed and analyzed for gamma radioactivity with a multichannel spectrometer (4 x 4-inch sodium iodide crystal). Concentrations of gamma-emitting fallout radioisotopes were monitored in Rangia over a 30mile stretch of river and a salinity range from less than 0.1 to greater than 15 parts per thousand. Ruthenium-106, cerium-144, cesium-137, manganese-54, and zinc-65 were present in all samples. After Chinese nuclear tests in May and December 1966, the amounts of cerium-141, ruthenium-103. zirconium-95, niobium-95, and barium-140-lanthanum-140 rose suddenly in the samples. Ruthenium-106 and ruthenium-103 were more concentrated in Rangia from downstream stations (salinity range 6-15 parts per thousand), whereas cesium-137 was more abundant in the same species from fresher water (salinity range 0-8 parts per thousand). Zirconium-95-niobium-95 from the Chinese test in May remained in Rangia from freshwater stations after it was no longer detectable in the same species collected downstream. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-W69-08527

TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPU-LATIONS.

Puerto Rico Nuclear Center, Mayaguez. Marine Biology Program.
D. K. Phelps, R. J. Santiago, D. Luciano, and N.

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 509-526. 7 fig, 2 tab, 25 ref, appendix.

Descriptors: *Benthic fauna, *Sea water, Iron. Descriptors: *Benthic tauna, *Sea water, Iron, Sediments, Copper, Ecology, Silts, Sands, Clays, Temperature, Depth, Food webs, Fish, Clams, Radioisotopes, Puerto Rico, Salinity, Gravels, Reefs, Stable isotopes, Trophic level, Digestion, Cycling nutrients, New England, Industries, Interfaces, Hydrogen ion concentration, Crustaceans. Identifiers: *Inshore fauna, *Offshore fauna, *Trace elements Zing, Seandium, Samarium, Tax-*Trace elements, Zinc, Scandium, Samarium, Taxonomic position, Scallops, Substrate, Anasco

River, Puerto Rico, Polychaetes, Nemerteans, Agloaphamus, Axiopsis, Capitellia, Biogeochemistry, Paraprionospio, Urophycis tenuis, Urophycis chuss, Terrebellid, Cirratuid, Sipunculid, Capitellid, Paraprionospio, Armandia, Magelonid, Orbiniid, Agloaphamus, Nemertea, Pilargiid, Glycerid, Ninoe, Amphipoda.

Preliminary studies of stable element partitioning within shallow water assemblages of infauna have shown discrimination between iron (Fe) and zinc (Zn) that follows feeding categories. Select deposit feeders concentrate Fe over ambient sedimentary levels, while non-select deposit feeders and om-nivores concentrate Zn. This study represents further investigation of relationships between distribution of Fe, Zn, copper (Cu), scandium (Sc), and samarium (Sm) and the ecology of benthic assemblages. Levels of Cu and Sm in fauna were enhanced by proximity to land mass. Iron and Sc were higher in fauna collected from silty clays than in fauna living in sands and gravelly sands, with no apparent increase due to influence of land mass. Zinc levels in animals showed no relationship to proximity of land mass or to changes in substrate, although higher values tended to occur in organisms found in offshore silts and clays. Relationships between content of stable elements and feeding types were substantiated. The physical and chemical state of the elements were related to their availability to feeding types. Organisms' content of stable elements were apparently not influenced by their taxonomic positions, environmental temperatures, or depth in which they occur. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08528

ELIMINATION AND TRANSPORT OF COBALT

BY MARINE ZOOPLANKTON, North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.

Edward J. Kuenzler.

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich. Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 483-492. 1 fig, 3 tab, 25 ref, disc.

Descriptors: *Zooplankton, *Marine animals, *Cobalt, *Cycling nutrients, Sea water, Thermocline, Pacific Ocean, Diffusion, Ecology, Physiology, Migration, Radioactivity, Tracers, Resins, Cobalt radioisotopes, Biomass, Fish, Ion exchange, Phytoplankton, Nekton, Geochemistry, Copepods, Crustaceans.

Identifiers: *Radionuclide elimination. *Radionuclide transport, Turnover time, Woods Hole Oceanographic Institution, Neocalanus gracilis, Pleuromamma xiphias, Pleuromamma abdominalis, Pyrosoma verticillatum, Siphonophores, Salpa cylindrica, Doliolids, Cheatognatha, Sagitta elegans, Sagitta enflata, Euchaeta media, Thysanopoda tricuspidata, Ostracods, Euphausids, Medusae, Pteropods, Cavolinia inflexa, Clio pyramidata, Styliola subula, Cuvierina columnella, Crab megalops, Ctenophore, Cephalapoda, Scaeurgus unicirrhus, Microflagellates.

Zooplankton are significant agents in cycling of cobalt in sea surface layers and in its transport through the termocline. Net hauls in eastern Pacific Ocean in spring 1962 showed that, over the whole day, mean biomass (wet weight) in the upper 100 meters was 3.87 grams/100 cubic meters, of which 42% were copepods, 13% pyrosomas, 13% siphonophores, 11% salps and doliolids, and 11% were chaetognaths. Diurnally migrating zooplankton amounted to 4.16 grams/square meter, consisting of 22% copepods, 19% pyrosomas, 20% siphonophores, 18% salps and doliolids, 6.5% medusae, and 4% chaetognaths. Using data from literature on cobalt content of zooplankton, of seawater and measured values of zooplankton cobalt elimination rates, turnover time for cobalt in the upper 100 meters was calculated to be about 13 years. Similarly, diurnally migrating zooplankton carry down and eliminate below the thermocline a quantity of cobalt equal to that in the upper 100 meters, in about 56 years. Transport of cobalt through the termocline by migrating zooplankton may often equal or exceed transport by vertical eddy diffusion. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-Wis) W69-08529

RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, Oregon State Univ., Corvallis. Dept. of Oceanog-

Norman F. Kujala, I. Lauren Larsen, and Charles I. Osterberg

Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 440-449. 6 fig, 4 tab, 21 ref.

Descriptors: *Radioisotopes, *Salmon, *Pacific Ocean, Gamma rays, Zinc radioisotopes, Man-ganese, Potassium radioisotopes, Cesium, Columbia River, Fresh water, Alaska, Fish, Trophic level, Monitoring, California, Fallout, Ecology, Spec-trometers, Radioactivity, Tagging, Migration, Age, Crabs, Plankton, Herrings, Mussels, Clams, Plankton, Herrings, Tracers, Gonads.

Iracers, Gonads.
Identifiers: *Viscera, Concentration, Plume, Halflife, Alaska, Bristol Bay, Asiatic stock, International problem, Cook Inlet, Petersburg, Canada,
Skeena River, Johnstone Strait, Barkley Sound, St Juan de Fuca, Oregon, Astoria, Depoe Bay, California, Eureka, Point Hope, Clupea pallasii, Euphausiids, Engraulis mordax, Cancer magister, Sebastodes, Tapeworms (Parasites), Japanese Fisheries Agency, Aleutian Island, Liver, Stomach, Pyloric caeca, Gills.

Pacific salmon, Oncorhynchus spp, concentrate certain gamma-emitting radionuclides--zinc-65 (Zn-65, manganese-54 (Mn-54), potassium-40, and cesium-137 (Cs-137)--in their viscera. In some cases, pattern of radionuclide concentration seems related to position of the Columbia River freshrutes a well-known source of Zn-65 in the water plume, a well-known source of Zn-65 in the northeast Pacific Ocean. Fishes whose migration paths were far south of the river had more Zn-65, but less Mn-54. Salmon in southeastern Alaskan waters displayed a distinct difference in relative abundance of Zn-65 and Mn-54. Manganese-54 was dominant isotope in salmon of northern Alskan waters and Zn-65 was more prominent in fish from Canadian and contingent United States waters. The Columbia River plume undoubtedly accounted for increase in Zn-65. Concentrations of radionuclides differ with species and stocks. Chinook and coho, which feed more on small fishes than the sockeye, which feed more on small lishes than the sockeye, accumulated the highest concentrations of Zn-65, Mn-54, and Cs-137. Sockeye, feeding on a lower trophic level, had low radioactivity, with Mn-54 the dominant radionuclide, some Zn-65, and no Cs-137. Chum and pink salmon most nearly resembled the sockeye in radioactivity. Ocean food habits and migratory nathways both across calcust to land. migratory pathways both appear relevant to levels of artificially produced gamma-emitters in salmon viscera. (See also Vol. 2, No. 18, Field 05C, W69-07441). (Jones-Wis) W69-08530

ZINC-65 IN ECHINODERMS AND SEDIMENTS IN THE MARINE ENVIRONMENT OFF OREGON,

Oregon State Univ., Corvallis. Dept. of Oceanog-

Oregon State Traphy:
Andrew G. Carey, Jr.
Available from Clearinghouse for Sci and Tech Information as CONF-670503. Symp on Radioecology, Proc 2nd Natl Symp, May 15-17, 1967, Ann Arbor, Mich, Nelson, Daniel J and Evans, Francis C (eds). US Atomic Energy Comm, Doc CONF 670503, p 380-388. 4 fig, 3 tab, 12 ref, disc.

Descriptors: *Zinc radioisotopes, *Sediments, *Marine animals, *Oregon, *Environment, Columbia River, Radioisotopes, Gamma rays, Spectrome-

ters, Benthic fauna, Depth, Distance, Ecology, Discharge (Water), Washington, Ecosystems, Bathymetry, Continental shelf, Continental slope, Sampling, Radioactivity, Detritus, Iron, Surface waters, Plankton, Nekton.

Identifiers: *Echinoderms. Hanford (Wash), Ocean bottom, British Columbia, Cascadia Abyssal Plain, Detector, Parastichopus californicus, Luidia foliolata, Pseudarchaster dissonus, Lophaster furcilliger, Zoroasteridae, Thrissacanthias penicillatus, Hymenaster, Heterozonias alternatus, Solaster borealis, Nearchaster aciculosus, Asteroids, Ophiura sarsii, Brisaster latifrons, Allocentrotus fragilis, Ctenodiscus crispatus, Paelopatides, River plume.

Role of benthic invertebrate organisms in determining fate of certain radionuclides in oceanic bottom has been studied. Artificial radionuclides, induced in water used as coolant in the Hanford reactors, are discharged into the Pacific Ocean by the Columbia River. Radionuclides from atmospheric atomic testing have also been detected in the environment. Gamma-ray spectrometric measure-ments show that levels of zinc-65 (Zn-65) decrease in both sediments and benthic animals with distance from the river mouth and with water depth. Although Zn-65 decreases rapidly in animals below 400 meters, it was detected to 2900 meter depths in animals, but not in sediments. Levels of Zn-65 in benthic animals appear to be associated with depth, distance from the point source, position of the Columbia River plume in the surface waters, and ecology of organisms. Bottom fauna is considered important in determining distribution of induced radionuclides. Some animals filter bottom water for food, while others ingest large quantities of sediment with associated organic materials. Marine organisms constantly remove certain elements from their environment, concentrating them in their tissues. There are intraspecific and interspecific variations in concentrations of Zn-65 in bottom organisms. (See also Vol. 2, No. 18, Field 5C, W69-07441). (Jones-W69-08531

WARM-WATER IRRIGATION: AN ANSWER TO THERMAL POLLUTION,

Eugene Water and Electric Board, Oreg.

Luther J. Carter. Science, Vol 165, No 3892, p 478-480, Aug 1969.

Descriptors: *Waste water disposal, *Irrigation, *Heated water, *Thermal powerplants, Nuclear powerplants, Irrigation water, Water temperature, Waste water (Pollution), Cooling water. Identifiers: Warm water irrigation.

The use of warm water for irrigation as a means of disposing of nuclear powerplant effluents is being studied in 2 projects in Oregon. The effects of warm water is controlling frost, lengthening the growing season, and stimulating plant growth are being evaluated. Water supply pipes buried in soil will supply both soil heat and irrigation water. Preliminary results suggest improvement in strawberry, string bean, and corn yield, but no dif-ferences in alfalfa, soybeans, and lima beans. (Knapp-USGS) W69-08561

BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, Southeast Water Lab., Athens, Ga.; and Mississippi

Air and Pollution Control Board, Jackson. For primary bibliographic entry see Field 05B. W69-08563

THERMAL DISCHARGES REQUIRE ADVANCE

PLANNING, Battelle-Northwest, Wash. Water Richland. Resources Systems Section. R. T. Jaske

Ind Water Eng, Vol 6, No 7, pp 18-21, July 1969. 4 p, 3 fig, 5 ref.

Descriptors: *Thermal powerplants, *Thermal pollution, Networks, Heated water, Systems analysis, Model studies, Path of pollutants, Water pollution effects, Pollution abatement, Planning. Identifiers: Thermal discharge planning.

Careful planning of nuclear powerplant locations and methods of handling of thermal discharges is necessary to prevent harmful thermal pollution. In general, the impact area of 1,000 MW production is about 5 1/2 sq mi. This corresponds to river lengths of about 10 mi on large, slow-moving streams, and much longer lengths on smaller and faster rivers. Mixing zones may be thermal barriers to fish movement. Although thorough mixing lengthens the impact area, minimizing the initial temperature differential is of greater value than maximizing heat loss rates by using high differential temperatures. The presence of dams changes the thermal regime, but the effect must be studied on the basis of individual cases. It is possible to regulate thermal regime by dams so as to permit construction of more powerplants than the unregulated stream could support, but this is practical only on large streams. The use of cooling towers allows greater freedom of plant location. Model studies may be used to calculate effects of plant distribution, networks, cooling, regulation, and economic factors. (Knapp-USGS) W69-08564

BIOLOGICAL CONCENTRATION OF PESTI-

CIDES BY ALGAE, North Texas State Univ., Denton. Dept. of Biology. B. Dwain Vance, and Waymon Drummond. J Amer Water Works Ass, Vol 61, No 7, p 360-362, July 1969. 3 p, 2 tab, 11 ref. Grant No CC00269 (PHS).

Descriptors: *Pesticide residues, *Algae, Bioassay, Bioindicators, Fishkill, Hazards, Pesticide kinetics, Pesticide toxicity, Pollutants, Water pollution effects, Aldrin, Dieldrin, Endrin, DDT. Identifiers: Pesticide bioaccumulation.

Algae, the base constituents of the aquatic food chain, concentrate pesticides and are much more resistant to toxic effects than the higher organisms that eat them. Algal cultures were grown in the presence of DDT, aldrin, dieldrin, and endrin, in concentrations of 5-20 microgram per ml. The algae concentrated the pesticides 100 times or more in all the tests. The data are tabulated. Practically no degradation of the pesticides occurred. (K-napp-USGS) W69-08565

A SYSTEMS ANALYSIS OF AQUATIC THER-

A SYSTEMS ANALYSIS OF AQUATIC THER-MAL POLLUTION AND ITS IMPLICATIONS: VOLUMES 1, SUMMARY REPORT, Travelers Research Corp., Hartford, Conn. Philip B. Cheney, Frank A. Smith, Robert O. Brush, Douglas J. Pelton, and James D. Kangos. Travelers Res Corp Rep No 7743-341a, Jan 1969. 30 p, 1 fig. 1 tab.

Descriptors: *Thermal pollution, *Water pollution effects, *Thermal powerplants, Costs, Economics, Legal aspects, Social aspects, Productivity, Regulation, Legislation, Governments, Systems analysis, Biological properties.
Identifiers: Thermal powerplant effluents.

A systems analysis study of thermal discharges was made to learn the broad thermal, environmental, and economic effects of releasing heated effluents to surface waters. Summaries are presented of steam-electric technology, waste heat production, heat disposal methods, effects on water bodies of waste heat, ecological effects of waste heat, social considerations, and costs of a number of possible regulations of heat disposal. (Knapp-USGS) W69-08599

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects of Pollution

LABORATORY INVESTIGATION OF THE EF-FECTS OF THERMAL ADDITIONS ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL, Sandy Hook Marine Lab., Highlands, N. J

J. B. Pearce, M. Silverman, and R. Le Goff. Sandy Hook Marine Lab Final Rep, Mar 1968. 21 p, 5 fig, 5 tab, 19 ref.

Descriptors: *Thermal pollution, *Water pollution effects, *Biological communities, Thermal power-plants, Water temperature, Fishkill, Fishing, Fish management, Cold-water fishing, Sport fishing, Commercial fishing.
Identifiers: *Cape Cod Canal (Mass).

Studies were made to predict the effects of thermal pollution on commercial fish and shellfish in Cape Cod Canal, Massachusetts. Suggestions are made for profitable uses of the heated waters. Tank and flume experiments showed that water temperatures approaching 77 deg F affect many of the fish and invertebrates in the canal. Winter flounder, one of the important sport fishes, are killed by 77 deg water. Other fish are somewhat more tolerant of high water temperatures. (Knapp-USGS) W69-08611

5D. Waste Treatment Processes

A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.

Federal Water Pollution Control Administration, Washington, D. C. Research Committee.

J Water Pollut Contr Federation, Vol 41, No 6, pp. 873-1251, June 1969. 378 p, 3,011 ref.

Descriptors: *Reviews, *Bibliographies, *Chemical analysis, *Water analysis, *Water chemistry, *Waste treatment, *Water quality, Analytical *Waste treatment, *Waster quality, Analytical techniques, Industrial wastes, Municipal wastes, Detergents, Biodegradation, Water pollution, Estuaries, Eutrophication, Radioactive wastes, Systems analysis, Thermal pollution. Identifiers: Pollution control literature review

A review covers 1968 literature on analytical methods (analysis of anions, cations, and gases; and instrumentation), biological filters, activated sludge, detergents, anaerobic processes, sludge treatment, disinfection, water reclamation and reuse, storm flow, facility evaluation, kinetic models, physical and chemical wastewater treat-ment, effects of pollution on aquatic life, eutrophication, thermal pollution, microbiology, oxygen sag, groundwater, marine and estuarine pollution, economics of treatment, standards, and industrial wastes (paper, fermentation, meat, dairy, canning, coal, tannery, steel, petroleum, plating, chemical, and radioactive). (Knapp-USGS)
W69-08199

RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER,
California State Dept. of Public Health, Berkeley.
Bureau of Sanitary Engineering.
Herbert B. Foster, Jr., and William F. Jopling.
ASCE Proc, J Sanit Eng Div, Vol 95, No SA3, Pap
6609, pp 503-514, June 1969. 12 p, append.

Descriptors: *Water reuse, *Reclaimed water, *Standards, *Water quality, *California, Waste water treatment, Tertiary treatment, Sewage treatment, Legulation. Identifiers: Reclaimed water standards (Calif).

California has established standards for reclaimed wastewater used for crop and landscape irrigation and recreational impoundments. Insofar as possible the standards avoid the use of specific quality parameters in order to minimize monitoring requirements which would be burdensome to small operations. The major exception is that, where a disinfected reclaimed waste water is necessary, daily coliform bacteria analyses are required. This requirement was one of 4 major controversial

points which are presented. Other major points raised in the development of standards are specifi-cation of operational controls and practices in the production and use of reclaimed waste water, and quality requirements for the various uses. (Knapp-

W69-08215

TREATMENT OF HIGH NITRATE WATERS,

Federal Water Pollution Control Administration, Fresno, Calif. San Joaquin Project; and Stanford Univ., Calif. Dept. of Environmental Engineering. Percy P. St. Amant, and Perry L. McCarty Amer Water Works Ass 89th Annu Conf, May 21 1969, San Diego, Calif, 1969. 18 p, 2 fig, 3 tab, 5

Descriptors: *Waste water treatment, *Denitrifica-Anaerobic conditions, Anaerobic bacteria, Filtration, Porous media, Aeration. Identifiers: Anaerobic filtration treatment.

Biological denitrification was investigated as an economically feasible way to remove nitrates from waters to control discharge of nutrients into bodies of water. Pilot-plant studies conducted to estimate chemical requirements, to evaluate anaerobic filter media, and to determine the operating parameters of the anaerobic filtration process. Biological denitrification in anaerobic filters is a reliable process for removing excess nitrates from water supplies. An organic electron donor must be added to accomplish dentrification and methanol has been found to be a satisfactory and inexpensive material for this purpose. Use of one-inch gravel filter media and a detention time of one hour is sufficient for 90% or greater removal of approximately 20 mg/1 of nitrate-nitrogen in water with temperature of 12 deg C and above. Costs, operating characteristics, and filter design data are tabulated (Knapp-USGS) W69-08228

RETURN FLOWS: A REUSABLE WATER

RESOURCE, Texas Water Development Board, Austin. John J. Vandertulip.

Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 106-109, 1967. 4 p, 1 tab.

Descriptors: *Water reuse, *Reclaimed water, Water Feues, Reclaimed water, Return flow, *Water sources, *Recirculated water, *Water quality, Water quality control, Water pollution control, Sewage treatment, Water quality Act, Industrial wastes, Municipal wastes, Water treatment, Water law, Water management (Applied).

Identifiers: Return flow reuse.

Return flows from various types of water uses constitute an important water resource to be evaluated in water planning. Benefits of increased quantities of available water may be offset by quality deterrents of pollutants. Industrial reuse of water by treatment or recirculation may offer a favorable economic solution to increased water requirements. Water resources planning, water quality management, and interagency coordination are essential factors in a regional approach to development of water resources and the effective integration of return into regional development analysis and water administration. (Knapp-USGS) W69-08259

REUSE CAN BE CHEAPER THAN DISPOSAL. Louis Koenig-Research, San Antonio, Tex.; and

Texas Univ., Austin. Louis Koenig, and Davis Ford. Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 143-147, 1967. 5 p, 3 fig, 2

Descriptors: *Water reuse, *Water costs, *Decision making, *Reclaimed water, *Waste water disposal, Costs, Injection wells, Water spreading, Sewage treatment, Tertiary treatment, Pipelines, Economics, Desalination, Distillation.

Identifiers: *Water reuse processing costs..

When disposing of waste water causes loss of valuable products, value of water supplies is high, effluents are strictly regulated, pollution drainages are excessive, or if effluent quality must be higher than the quality of available raw water, it is cheaper to reuse water than dispose of it. Cost curves show that if new water costs \$5 per thousand gal, the combined cost of disposal and water purchase is always more than the cost of any type of reuse processing on any waste waters. Costs of disposal, treatment, conveyance, and reuse processing are tabulated and shown graphically to permit comparison of costs of alternatives. The information is the result of a parametric cost study of each process to determine costs, sensitivity of final costs to the parameters, and estimate the usual values of the parameters. For example, it can be determined that any reuse process is cheaper than disposal in mined cavities, but disposal by spreading is cheaper than any reuse. Thermal evaporation or deionization from 2,500 ppm is more expensive than any disposal, but these processes are cheaper than injection or transport of 50 mi if wastes are weaker than 1,500 ppm. Treatment for reuse by coagulation, filtration, and sedimentation, or standard secondary sewage treatment, is cheaper than injection or transport over about 5 mi. (Knapp-USGS) W69-08260

WATER REUSE IN SPACE, General Electric Co., Philadelphia, Pa. Fred P Rudek

Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 210-217, 1967. 8 p, 6 fig, 2 tab. 16 ref.

Descriptors: *Water reuse, *Recirculated water, *Reclaimed water, Electrodialysis, Reverse osmosis, Membrane processes, Filtration, Ion exchange, Water sources, Potable water. Identifiers: *Spacecraft wastes, Pyrolysis.

Water recovery systems for spacecraft must be reliable, light, compact, and produce water that is aesthetically unobjectionable. The emphasis to date has been to develop simple, once-through systems that offer foolproof process characteristics. That is, if they are operational they are most likely operating correctly. The liquid to vapor phase change processes seem to most readily satisfy this requirement. They do so, however, at the expense of system weight, complexity, power requirements, The challenge to develop a true long-term water recovery system lies in the elimination of preand post-treatment chemicals, mechanically comddevices, and excessive electrical power requirements. To date the system offering the greatest potential for minimizing expendables and electrical requirements appears to be the radioisotope-powered vacuum distillation-vapor pyrolysis unit. This system has been operated for 30 consecutive days, providing potable water from urine and wash water. No pre- or post-treatment chemicals or filters were required. The 1,200 deg F pyrolysis temperature insures a bacteria-free vapor, thereby eliminating a potentially serious problem. This unit appears to offer the greatest capability for extended life and scale-up for larger crews since little or no electrical power increase would be anticipated. At present the life limitation lies in the ability to maintain the catalyst surface in the active state. To data, 30 days of continuous operation for a prototype water recovery system have been achieved. We are still a long way from the 450-day system required for the manned planetary flyby missions. (Knapp-USGS) W69-08261

POTENTIAL REUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN,

Texas Technological Coll., Lubbock. George A. Whetstone.

Water Reuse, Amer Inst Chem Eng Progr Symp, Ser No 78, Vol 63, pp 255-257, 1967. 3 p, 35 ref.

Descriptors: *Sewage treatment, *Water reuse, *Tertiary treatment, *Design criteria, Design flow, Sewers, Waste water disposal, Reclaimed water, Costs.

Identifiers: Sewage system design, Sewage system costs.

Traditionally, overloaded sewers have been paralleled or replaced. Modern sewage treatment plants, capable of producing high-quality effluent by nuisance-free processes on small plots of land, per-mit a more satisfactory solution. Now, a plant may be placed within convenient distance of the point of incipient overload, and the effluent may be employed for a beneficial consumptive use near the treatment plant. Thus existing sewers remain adequate, or new sewers may be planned with less provision for unknowable future loads. (Knapp-USGS)
W69-08262

COMPLETE WATER REUSE,

Lawrence K. Cecil.

Water Reuse, Amer Inst Chem Eng Progr Symp,
Ser No 78, Vol 63, pp 258-261, 1967. 4 p, 16 ref.

Descriptors: *Water reuse, *Sewage treatment, *Tertiary treatment, Municipal wastes, Reclaimed water, Activated sludge, Filtration, Ion exchange. Identifiers: Municipal water reclamation.

Water reuse, tertiary treatment, and pollution control systems and literature are reviewed. A total treatment scheme for water reuse and prevention of nutrient addition to natural waters is presented. It consists of solids removal, activated sludge treatment for phosphorus, nitrate and BOD removal, chemical precipitation, ion exchange, and sterilization. About 95% of the input water is recovered. No wastes are returned to the watershed. (Knapp-USGS) W69-08263

WATER REUSE IN MONTERREY, MEXICO.

Celulosa y Derivados S.A., Monterrey (Mexico). Copropiedad Grupo Quimico.

Hector J. Gomez.

Journal Water Pollution Control Federation, Vol 40, No 4, pp 540-545, 1968. 6 p, 1 fig.

Descriptors: *Water reuse, *Municipal wastes, Water chemistry, Boiler feed water, Water quality control, Cooling water, Industrial water, shortage, Water utilization efficiency, Water conservation, Reclaimed water, Waste water treatment, Cost comparisons, Economy. Identifiers: Monterrey (Mexico).

Aridity, an extended drought, industrial development and the population explosion necessitated water reuse as early as 1955. Some industries treat and reuse water individually, while others use the central treatment facility of a cooperative. Water quality treatment varies with use demands. Uses are for watering gardens, cleaning of buildings and equipment, fire protection, cooling, boiler feed, and various industrial processes. Production costs as well as physical and chemical properties of the water presented for each quality use type. (Sherbrooke-Ariz) W69-08289

WASTEWATER REUSE AT THE GRAND CANYON.

Arizona State Dept. of Health, Phoenix Edmund C. Garthe, and Wilfred C. Gilbert. J Water Pollut Contr Fed, Vol 40, No 9, pp 1582-1585, 1968. 4 p.

Descriptors: *Water reuse, *Arizona, Arid lands, Groundwater movement, Water rates, Water sources, Water conservation, Water utilization efficiency, Activated sludge, Chlorination, Reclaimed water, Treatment facilities, Cost comparisons, Water costs. Identifiers: *Grand Canyon.

This paper traces water problems and wastewater reuse at the south rim of the Grand Canyon from the late 1800's to the present. Reclamation efforts began in 1924 with construction of an activated sludge plant supplemented by an anthracite coal filter and chlorination. Treated water was used for toilets, boiler feed water, cooling water and irriga-tion. Treatment cost of \$0.59/1,000 gal. compared favorably to railroad transported water at \$3.09/1,000 gal. Additional water was pumped up from Indian Gardens in 1934. Detailed records of cost have been kept by the National Park Service since 1951. Presently, construction of a pipeline from Roaring Springs, on the more water rich north rim, presents the possibilities of abandoning the water reuse system, constructing newer facilities, or continuing the 40-year old plant. Whatever the future, the plant at Grand Canyon has demonstrated that wastewater reuse is an economically sound concept. (Sherbrooke-Ariz) W69-08290

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.

Louis T. Kardos, and Earl A. Myers.
Institute for Research on Land and Water
Resources, Research Project Technical Completion Report, University Park, Pa., June 1969. 6 p, 3
append. OWRR B-001-PA.

Descriptors: *Sewage effluents, *Wastewater, *Surface runoff, *Subsurface runoff, *Nitrates, Infiltration, Percolation, Soil water, Nitrites, Ammonium compounds, Maganese, Iron, Nitrification. Identifiers: *Soil aeration, *Oxygen diffusion rate, *Suction lysimeter, Piezometer head, Artesian

Hydrologic studies on two soil sites indicate that soil permeability can be a highly critical control of son permeability can be a nightly critical control of hydraulic acceptance of sewage effluent waste water applied to a sloping disposal area. Variations in vertical permeability of the soil resulted in perched water tables and artesian phenomena, with interflow appearing downslope as surface runoff. Total surface runoff ranged from 0 percent of the waste water application during periods of high evapotranspiration to 100 percent on frozen, ice-coated soil. The cycling of effluent application at weekly intervals permitted the soil to remain aerobic as measured by oxygen diffusion rates and gaseous oxygen concentration in the soil profile to a depth of 24 inches. The aerobic condition was reflected in the presence of nitrate as the dominant form of nitrogen in the soil water samples obtained from suction lysimeters at the 6-and 24-inch depth. Nitrite concentrations were generally less than 0.05 mg per liter, and manganese and iron concentrations in the effluent-treated area were not significantly different from those found in the control area. (Pollard-Penn State University) W69-08377

SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE WATER,

West Virginia Univ., Morgantown.
Raymond C. Kralovic, and H. A. Wilson.
Water Research Institute Research Report 1, 1969.
OWRR Project A-002-WVA.

Descriptors: *Acid mine water, *Sewage, *Yeasts, *Microorganisms, Microbiology, Biochemical oxygen demand, Hydrogen ion concentration. Identifiers: *Acid-tolerant bacteria, Oxygen utiliza-

Numbers and types of bacteria decrease if the pH of sewage is lowered by addition of acid mine water. A rapid decrease occurs at 4 C and 22 C microbial numbers increase after the initial decrease. The biochemical oxygen demand (BOD) of sewage and acid-mine-water mixtures decreases the pH of the mixture decreases. as the pH of the mixture decreases. At pH 3.5, there is a lag period before much biochemical oxidation occurs. Oxygen utilization is greater if yeasts are inoculated into a sterile sewage and acidmine-water mixture than when bacteria are used. If together, utilization is greater than for either alone. Qualitative and quantitative microbial estimations were made on Monongahela River water which contains domestic raw sewage and acid mine water. Yeasts were the dominant organisms if the plating medium was at pH 4.0, and bacteria were dominant if the medium was about pH 7.0. The actually acidtolerant bacteria that will grow in sewage and acid-mine-water mixtures at pH 4.0 probably represent only a few genera. Four such isolates were identified as Bacillus species. Other isolates were identified as Micrococcus candidus and Kurthia variabilis. (Wilson-W Va) W69-08400

AN INVESTIGATION OF POTENTIAL IN-TERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.

Harold L. Lovell, and James L. Sloughfy Resources, Research on Land and Water Resources, Research Project, Technical Completion Report, University Park, Pa, June 1969. 176 p, 1 append, 23 tab, 23 fig. OWRR B-004-PA.

Descriptors: *Mine drainage water, *Acidity, *Neutralization, Coal, Treatment, Activated carbon, Ion, Water quality, Alkalinity, Ion exchange, Absorption, Temperature, Settling rates.
Identifiers: *Coal products, *Steam activation,
Mineral matter, Sulphuric acid, Steam activation, Surface area, Reaction rates.

The potential for using coal or coal-products (including commercial activated carbon) for treating mine water was considered. Certain coals whose inherent mineral matter have the capacity to reduce acidity are being employed industrially. Acidity reduction by the organic phases of coal is nil. Coal products heated to 450 degree C in a nitrogen or steam atmosphere have a little acid-reduction response. Coal activated by steam at 800 degree C develops increased specific surfaces, including complex carbon oxides which have the ability to reduce acidity. The properties of such products and commercial activated carbons may have potential in treating these and other polluted waters. (Pollard-Penn State Univ) W69-08466

MATHEMATICAL MODEL FOR DISSOLVED

Public Health Service, Philadelphia, Pa. Delaware Estuary Comprehensive Study. Robert V. Thomann.

Proc, Amer Soc Civil Eng, Vol 89, No SA5, p 1-30, Oct 1963, 30 p, 3 fig.

Descriptors: *Mathematical models, *Dissolved oxygen, *Optimization, *Waste treatment, *Systems analysis, Time series analysis, Sewage effluents, Streams, Digital computers, Analog com-

A mathematical model was presented for describing time variations of dissolved oxygen (DO) in a finite number of sections in a body of water for optimal sewage treatment. The model, as presented in its general form, embodies all types of inputs and was capable of assessing the effects of any one time varying input in one section of the water body on the DO in any other section. Systems analysis techniques were employed and the DO response equations resulting from the imposition of general input forcing functions were derived. An analytical relationship was developed between the time variation of the sewage effluent in one section and the DO response in any other section. The dependent variable could assume the role of any water quality constituent. Although the systems techniques were general, the analytical model was presented for the case of an estuary without any analytical difficulties. Non-tidal streams were a special case of the general formulation. The model was capable of

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

being solved by digital or analog computers. (Thiuri-Cornell) W69-08532

OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORA-

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab. Robert Smith.

Proc, Nat Symp Anal Water Resource Syst, p 241-260, Denver, July 1968. 20 p, 14 fig, 5 ref.

Descriptors: *Water resources, *Operations research, *Waste water treatment, *Mathematical models, *Planning, Design, Optimization, Control systems, Time, Stream improvement, Activated sludge.

Identifiers: Cincinnati Water Research Laboratory, Quasi steady state.

Operations research activities at the Cincinnati Water Research Laboratory were discussed. Operations research activities at CWRL were directed towards the development of mathematical models to represent the performance and cost of all practicable wastewater treatment processes, and the use of the information obtained for the advancement of planning, design and control of wastewater treatment. Two principal types of mathematical models were studied; the quasi steady state model and the time dependent model. The quasi steady state model was based on 24 hours composite measurements and was intended for planning and design of wastewater treatment systems to accomplish a specific treatment task at minimum cost. The time dependent model was used for the study of the practicability of various schemes for controlling processes which receive highly variable intermittent loads. It was concluded that by means of process control the variability of the effluent stream quality and the average performance of the process can be improved. W69-08534

A TEST OF THE HYPOTHESIS THAT POLLU-TION CONTROL IS WORTH WHAT IT COSTS, Delaware Univ., Newark. Urban Affairs Div. Robert F. Minnehan.

Proc, Water Resources Seminar 1967-1968, pp 19-52, Univ Del, Newark, Dec 1968. 34 p, 1 tab, 4 fig.

Descriptors: *Mathematical models, *Water quality control, *Pollution abatement, *Optimization, *Cost-benefit analysis, Waste water treatment, Economics, Biochemical oxygen demand, Water resources, Delaware River. Identifiers: San Francisco Bay.

A benefit-cost mathematical model was developed for water quality evaluation in order to determine whether water pollution control is always worth what it costs and what is the optimal degree of waste reduction. The model's equations were then fitted with coefficients that approximated benefits and costs, with Delaware River Estuary and San Francisco Bay as examples. The results indicated that a high level of treatment is not justified when the total waste load is small in relationship to the assimilative capacity of the stream or adjacent watercourse. The results also indicated that although complete BOD removal is required to maximize net benefits in a heavily polluted river, the costs of waste treatment may exceed the benefits and the control program may not be justified economically. An evaluation of optimal treatment level revealed that the benefit cost ratio was an increasing and a decreasing function of BOD removal. With growth in the quantity of waste flow there may be a point in time where the benefits of pollution abatement will always be less than costs and optimal treatment increased as the quantity of waste flow increased. (Thiuri-Cornell) W69-08542

TREATING WASTES IN A WATER-SHORT

AREA, Texas Technological Coll., Lubbock.

H. E. Clay.

Textile Chemist and Colorist, Vol 1, No 7, p 176/28-179/32, March 26, 1969. Based on a sym-posium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior.

Descriptors: *Water shortage, *Activated sludge, Biochemical oxygen demand, Chemical oxygen demand, Waste treatment, Aerobic treatment Identifiers: *Anaerobic contact process, Textile

The approach to, and results of, a laboratory study, designed to provide information on the treatability of concentrated wastes produced by textile mills operating in water short areas, are given. Because of high costs of water and scarcity of water in such areas, mill effluents contain very high concentrations of pollutants. Data on the characteristics of raw waste, operating results for activated sludge plant, and operating results for anaerobic contact process are discussed. It was concluded that highly concentrated textile wastes could be effectively treated by both aerobic and anaerobic processes with BOD reductions of 90%. The anaerobic control process is believed potentially better suited. (Livengood-NC State Univ) W69-08551

WHAT THE MILLS ARE DOING TO CONTROL

WATER POLLUTION, B. V. Hill, J. L. Brown, Jr., A. L. Smith, T. A

Alspaugh, and J. C. Pangle, Jr. Based on a symposium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Department of Commerce and Interior. Textile Chemist and Colorist, Vol 1, No 6, p 146/25-156/35, March 12,

Descriptors: *Settling basins, *Biochemical oxygen demand, *Aeration, *Trickling filters, *Lagoons, *Activated sludge, *Anaerobic digestion, *Aero-*Activated sludge, *Anaerobic digestion, *Aerobic, Treatment, *Treatment facilities, Sodium sulfate, Domestic wastes, Equalizing reservoirs, Chemical wastes, Biological treatment, Chemical

precipitation, Flocculation.
Identifiers: *Recovery (Waste), Zinc sulphate,
Dyeing wastes, Bleaching wastes, Dow surfpac
filter, Clarifier.

This article discusses what has been done by seven textile companies to solve the pollution problem. American Enka has constructed three settling basins, an anhydrous sodium sulfate recovery plant, an extended aeration system, and a system for the removal of zinc sulfate from waste water. Detailed descriptions are given. The majority of Burlington Industries' plants employ a modified activated sludge system to treat their wastes. Cannon Mills' treatment plant employs primary settling basins, equalization tanks, aeration for dye wastes, caustic storage tanks for pH control and a two-stage trickling filter. A detailed description of Chatham Mfg. Co.s' aerated lagoon is given. A description of Cone Mills' biological treatment plant which employs high rate filtration, activated sludge and aerobic lagooning alone and in variation is given. Dan River Mills' employs an aerobic lagoon, an aerobicanaerobic lagoon, a clarifier, an activated sludge basin, a Dow Surfpac filter, and a chemical precipitation unit. A description of M. Lowenstein and Sons' pumping station, screening facility, and basins are given. (Goodwin-NC State Univ) W69-08556

RESEARCH ON TREATMENT OF DYE

WASTES, Virginia Polytechnic Inst., Blacksburg, Va. D. L. Michelsen.

Based on a symposium, February 26-18, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior. Textile Chemists and Colorist, Vol 1, No 7, p 179/32-181/35, March 26,

Descriptors: *Aeration, *Foam fractionation, *Coagulation, *Biological treatment, Biochemical oxygen demand, Chemical oxygen demand. Identifiers: *Disperse dyes, *Dyeing wastes.

Recent research projects at Virginia Polytechnic Institute on the treatment of disperse dye wastes are described and results given. Studies discussed were: (1) the effect of aerated biological treatment of the chemical coagulation demand to effect removal of color from disperse dye wastes using foam fractionation. The results of these studies are not encouraging as these treatments of disperse dye wastes have been only partially successful. (Livengood-NC State Univ) W69-08558

MUNICIPAL SEWAGE EFFLUENT FOR IR-RIGATION

Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Instit, Ruston, 1968. 169 p, 4 fig, 16 tab, 260 ref, 1 append. Wilson, C. W., Beckett, F. E., Editors.

Descriptors: *Water reuse, *Municipal wastes, *Water sources, *Irrigation water, Public health, Economics, Soil investigations, Legal aspects, Crop response, Water pollution sources. Identifiers: Municipal waste water reuse, Irrigation.

A symposium was held to discuss the use of municipal sewage effluents for irrigation. Large amounts of relatively pure water are discharged from sewage plants in the United States. Most of this water finds its way into streams. Wastewater may be viewed as a wasted resource or as a pollution problem. It is a valuable resource in that it could be used to irrigate a large acreage of land. It is a problem in that it usually contains an appreciable concentration of plant nutrients which may cause an excessive amount of algae to grow in the body of water into which it is discharged. Municipal sewage effluent is used for irrigation in a few places in the United States. Most of these are located in the western part of the country. Papers covering health, economics, soil effects, water pollution effects, legal considerations, and crop response are among those included. A brief summary of the discussion generated by each paper is given. (Knapp-USGS) W69-08615

SOIL RESPONSE TO SEWAGE EFFLUENT IR-RIGATION.

Robert S. Kerr Water Research Center, Ada, Okla.

R. E. Thomas, and James P. Law, Jr.
Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 5-15, 1968. 11 p, 41 ref.

Descriptors: *Water reuse, *Artificial recharge, *Irrigation water, Soil disposal fields, Soil chemistry, Water quality, Water chemistry, Waste water disposal, Sewage treatment, Nutrients, Water pol-lution control, Soil water movement. Identifiers: Wastewater - soil relationships,

Eutrophication prevention.

Recent emphasis on water pollution control has stimulated research on the application of waste-waters to the land. About 2/3 of the more than 1,300 systems in operation were designed for treatment of a wastewater rather than irrigation of economic crops. A variety of needs and empirical solutions have resulted in the evolution of several system designs. Each of these designs has advantages for particular operating conditions. Some wastewaters are unsuitable for irrigation because toxic or excessive concentrations of pollutants are added during the use cycle. Many industrial and most domestic wastewaters are suitable for irrigation use under good management practices. Wastewater can cause beneficial or detrimental changes in physical and chemical properties of soil. With good management practices and system designs, the beneficial effects are greater than the detrimental effects. Wastewaters receive treatment as they percolate through the soil. Systems can be designed and operated to accentuate this treatment. resulting soil percolate is immediately suitable for many reuse purposes. (Knapp-USGS) W69-08616

CROP RESPONSE TO SEWAGE EFFLUENT, Pennsylvania State Univ., University Park. Dept. of

Soil Technology. Louis T. Kardos.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 21-27, 1968. 7 p, 5 tab, 13 ref.

Descriptors: *Soil disposal fields, *Water reuse, *Irrigation water, Soil-water-plant relationships, Soil chemistry, Water quality, Water chemistry, Waste water disposal, Sewage treatment, Nutrients, Water pollution control, Soil water movement. Identifiers: Wastewater-soil relationships, Eutrophication prevention.

Sewage effluents are highly enriched with plant nutrients, and usually are beneficial to agronomic crops when used as irrigation water. Experiments were conducted irrigating crops on Hublersburg-Hagerstown soils with surface textures ranging from silt loam to silty clay loam with slopes from 3 15%. Waste water was applied at 0.25-0.64 inches per hr to totals of 0,1, and 2 inches per week. The fertilizer equivalent of the nutrients in the water was 2000 lb. of 7-12-11 per ac in 1963, 2000 lb. of 14-15-14 in 1964, 2000 lb. of 5-10-5 in 1965, and 2000 lb. of 9-9-16 in 1966. Crop yields are tabulated. Harvest of corn removed nutrients equivalent to 202% of applied N, 39% of applied P, and 62% of applied K. Most of the applied P was fixed in the soil. The soil-water-plant system efficiently prevented nutrients from reaching surface waters or the water table. (Knapp-USGS) W69-08617

SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION.

Utah State Univ., Logan. Dept. of Irrigation.

H. B. Peterson.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 31-43, 1968. 13 p, 5 tab, 8 ref.

Descriptors: *Water reuse, *Municipal wastes, *Irrigation water, *Salinity, Saline soils, Soil chemistry, Water quality, Saline water, Water chemistry, Soil contamination. Identifiers: Salinity hazard.

In programs of irrigation with municipal waste effluents, the build-up of soluble salts, which can increase the osmotic pressure of the soil solution, can be prevented by providing for adequate drainage and by applying enough excess irrigation water to maintain a favorable salt balance. In humid areas, the rainy season is likely to provide the necessary leaching. Even with good drainage and sufficient leaching to remove normal amounts of soluble salts, it is possible to have an accumulation of exchangeable sodium and precipitated or adsorbed heavy metals that can adversely affect the soil and crops. A build-up of salts is very much less likely where an effluent is used to supplement normal rainfall in humid areas than if it is used in an arid climate where irrigation supplies the major portion of the water required for a crop. Relatively low concentrations of sodium and chloride salts applied on foiliage can cause harmful salt build-up on sensitive crops. Boron is of special concern when effluent is used for irrigation because the tolerance for drinking water can be greater than for irriga-tion. There is a great variation in the salt content of sewage that reaches different treatment plants and considerable variation in that reaching a given treatment plant. These variations are reflected in the effluent. Some of the soluble metal salts are removed by precipitation or chelation during the treatment process. Zinc is most readily removed by treatment and nickel the least. Short term irrigation trials with effluent may fail to reveal a build-up potential. Accumulations of heavy metals in soils constitutes a unique hazard because of inadequate methods for reclamation. (Knapp-USGS) W69-08618

PRACTICAL IRRIGATION WITH SEWAGE EF-FLUENT.

Frank J. Gray

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, pp 49-56, 1968.8 p.

Descriptors: *Water reuse, *Reclaimed water, *Municipal wastes, *Texas, *Irrigation water, Aesthetics, Odor, Nutrients, Soil chemistry, Water quality, Soil-water-plant relationships, Waste water Water pollution control, Artificial disposal,

Identifiers: *Lubbock (Tex):

The use of municipal sewage effluent for irrigation at Lubbock, Texas is described. The practice is successful in increasing crop yields, preventing pollution, improving soil conditions, and recharging groundwater. Disadvantages are steadiness of supply despite fluctuating demand, odor, difficulties in retaining agricultural laborers, and a few seedling growth problems. (Knapp-USGS) W69-08619

GROUNDWATER RECHARGE TREATED MUNICIPAL EFFLUENT, WITH

Texas Technological Coll. Lubbock. Water Resources Center; and Texas Technological Coll., Lubbock. Dept. of Engineering. Dan M. Wells.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 61-73, 1968. 13 p, 1 tab, 46 ref. OWRR Proj No A-009-

Descriptors: *Water reuse, *Reclaimed water, *Municipal wastes, *Artificial recharge, Legal aspects, Aesthetics, Aquifers, Soil water movement, Groundwater movement, Infiltration, Water chemistry, Water quality, Soil contamination. Identifiers: Waste water recharge.

Municipal effluent has always been used for groundwater recharge. Practically all of the recharge in the past has been unintentional, resulting from the natural operation of the hydrologic cycle, and it does not appear that this pattern will be appreciably changed in the future. It does appear, however, that the deliberate use of treated effluent for groundwater recharge will increase in the fu-ture, particularly in arid and semi-arid areas of the country that are rapidly depleting their groundwater resources. Although the technological capability for treating municipal effluent for any type of reuse including the recharge of potable ground-water supplies has existed for many years, many psychological problems remain to be solved to win psychological problems remain to be solved to win public acceptance for its widespread use. Physical problems include clogging of soils of aquifers, chemical precipitation, and algal or bacterial growth. The legal problems include liability for damages to aquifers, ownership of recharged water, and ownership of effluent water. (Knapp-USGS) W69-086-20

THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS,

California Univ., Davis, Dept. of Civil Engineering. R. B. Krone.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 75-104, 1968. 30 p, 2 fig, 55 ref.

Descriptors: *Water reuse, *Pathogenic bacteria, *Viruses, *Groundwater movement, Municipal wastes, Irrigation water, Artificial recharge, Filtration, Sorption, Infiltration, Percolation, Soil-disposal fields, Soil contamination, Soil physical properties.

Identifiers: Municipal waste recharge.

The movement of pathogenic organisms through soils recharged with contaminated water is discussed. Pathogens have a wide variety of physical and biological characteristics, including wide ranges of size, shape, surface properties, and die-away rates. The processes of filtration by soil include straining at the soil surface, straining at intergrain contacts, sedimentation, and sorption by soil particles. Straining of pathogens at the soil surface and sorption of viruses near the soil surface is desirable because it limits travel of pathogens most, and it is subject to wide variations in temperature and moisture, and it will assure aerobic conditions. A soil containing clay should therefore be used for irrigation with treated sewage. Wide experience in irrigation with treated sewage indicates that it is safe provided that at least primary treatment is used, and provided that the crops are not consumed directly by humans. Secondary treatment and chlorination is recommended for aesthetic reasons. (Knapp-USGS) W69-08621

SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS,

Colorado Univ., Denver. Dept. of Microbiology.

Stuart G. Dunlop.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, pp 107-121, 1968. 15 p, 1 tab, 62 ref.

Descriptors: *Hazards, *Irrigation water, *Reclaimed water, *Municipal wastes, Pathogenic bacteria, Viruses, Parasitism, Waste treatment, Environmental sanitation. Identifiers: Waste water irrigation.

The hazards to health caused by irrigation with reclaimed municipal waste water are surveyed. No disease outbreaks have been traced to irrigation with properly treated and disinfected sewage, but many epidemics have been caused by irrigation with improperly treated wastes. The same standards are recommended for effluents as for any other irrigation water. Survival times of pathogenic organisms in water are discussed and tabulated. (Knapp-USGS) W69-08622

A TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION,

Soil Conservation Service, Searcy, Ark.; and Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering. Robert P. Cantrell, Charles W. Wilson, F. E.

Beckett, and F. A. Calvo.

Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 135-156, 1968. 22 p, 1 fig, 3 tab, 19 ref, append.

Descriptors: *Water reuse, *Reclaimed water, *Municipal wastes, *Irrigation water, *Costs, Economics, Water pollution control, Nutrients, Water costs, Water wells, Legal aspects. Identifiers: Ruston (La).

A study of technical and economic feasibility of irrigation reuse of Ruston, La. municipal wastewater effluents show that there are no significant technical problems. Neither corrosion nor salinity hazard to crops is expected to cause severe problems. Sprinkler irrigation using waste water is safe for field crops and pasture but is not recommended for fruits and vegetables. Furrow irrigation of fruit trees, as long as effluent does not contact the fruit. is acceptable. The cost of using effluents compares favorably with costs of other water sources. For the farms studied, average annual cost was \$54.82 per acre, compared with \$105.87 per acre for well water. This did not account for the fertilizer value of the effluent, which was about \$17.50 per acre-ft. (Knapp-USGS) W69-08623

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, Nevada Univ, Reno. Dept. of Civil Engineering; and Nevada Univ., Reno. Center for Water Resources Research. Richard G. Orcutt.

Desert Res Inst Tech Rep HW-5, Nev Univ, Oct 1967. 123 p, 17 fig, 12 tab, 47 ref, 3 append. OWRR Proj No A-008-NEV.

Descriptors: *Water reuse, *Artificial recharge, *Irrigation water, *Arid lands, *Nevada, Mathematical models, Systems analysis, Model studies, Hydraulic models, Transmissivity, Aquifers, Groundwater movement, Water yield, Water quality, Water storage, Sanitary engineering, Water pollution, Optimization, Economics. Identifiers: *Hele-Shaw models, Las Vegas (Nev).

An engineering-economic model of systems utilizing aquifer storage for the irrigation of public parks and golf courses with reclaimed municipal waste-water was developed and a computer program for the production costs for these systems was written.

One model criterion was the essentially complete recovery of the injected water from the aquifer. A sensitivity analysis studied the effects of varying the input parameters, which represented decision variables and constants with uncertain values, upon the cost of reclaimed water. Preliminary feasibilities were studied for selected sites in Las Vegas, Nevada. A Hele-Shaw model was used to estimate the amount of groundwater withdrawal for essentially complete recovery of the injected reclaimed water. The benefits which might be attributed to the relief of sewerage by wastewater reclamation systems in Las Vegas, Nevada, were estimated. The model rapidly determines the cost effect of varying about 40 input parameters. A significant finding is the important influence which the injection rate, particularly for rates under 0.75 cfs per well, has upon water cost. The successful development of reclamation-reuse systems utilizing aquifer storage will require close cooperation between the agency which is responsible for the project and public health agencies at all levels. A complete Fortran program listing for the mathematical model is included. (Knapp-USGS) W69-08625

5E. Ultimate Disposal of Wastes

SEWAGE D SHORELINES. DISPOSAL SYSTEMS **NEAR**

NH Rev Stat Ann secs 149-E:1 thru 149-E:8 (Supp 1967). -

Descriptors: *New Hampshire, *Water pollution sources, *Sewage disposal, *Sewage treatment, Sewage, Legislation, Wastes, Municipal wastes, Water pollution control, Disposal, Environmental engineering, Waste water disposal, Shores, Shore protection, Administrative agencies, Planning, Land development, Soil contamination, Soil contamination effects, Jurisdiction, Legal aspects.

The purpose of this chapter is to prevent water pollution by inadequate waste disposal systems near shorelines. Anyone proposing to subdivide land or construct a sewage disposal system near any shoreline shall submit such plans for approval by the Water Supply and Pollution Control Commission. The disposal systems shall be constructed in accordance with the approved plans. The commission shall notify the person submitting plans of their approval or disapproval. No plans shall be required when the system will be connected to a public sewer system. The commission will require the submission of any soil data from any subdivision to be built. Anyone aggrieved by the decision of the commission may appeal in accordance with the established procedure. The commission shall be empowered to: (1) supervise and enforce this chapter; (2) employ necessary personnel; (3) adopt, after public hearings, rules and standards to

implement this chapter; and (4) prohibit construction of any sewage system which would cause pollution. Upon certification by the commission, local officials may exercise concurrent jurisdiction with the commission in enforcing this chapter. Violations of these provisions shall be punishable by a fine and the acts may be enjoined. (Helwig-Fla) W69-08154

STATUS OF RADIOACTIVE WASTE DISPOSAL

Vanderbilt Univ., Nashville, Tenn. Dept. of Sanitary and Water Resources Engineering. Frank L. Parker.

ASCE Proc, J Sanit Eng Div, Vol 95, No SA3, Pap No 6597, pp 439-464, June 1969. 26 p, 9 fig, 5 tab, 60 ref.

Descriptors: *Radioactive *Reviews, *Bibliographies, *Radioactive waste Systems analysis, Waste disposal, Injection wells, Monitoring, Regulation, Radiochemical analysis, Pollutant identification, Water pollution control. Identifiers: Underground grouting (Disposal).

The present state of radioactive waste disposal practices is reviewed. The main emphasis in research in liquid radioactive waste management has been on the feasibility of conversion of liquids to solid form before disposal and in place underground, and monitoring of disposal and pollution effects. For gaseous wastes, the emphasis has been on the removal of the various forms of iodine in the off-gas systems and the development of new methods for noble gas removal. For solid waste disposal, better containment has been sought, and private burial operations have been transferred to commercial burial grounds. The management of radioactive wastes has not proven to be a deterent to a nuclear power economy. The major problems remaining are methods of the removal of noble gases and tritium, development of methods of fuel reprocessing, and understanding of the movements radionuclides in the environment. (Knapp-W69-08214

5F. Water Treatment and **Quality Alteration**

PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER SUPPLIES, New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 05C. W69-08282

CLASSIFICATION OF WATERS AND STAN-DARDS OF PURITY.

SC Code Ann secs 70-112 thru 70-122 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water pollution control, *Classification, *Standards, Administration, Administrative agencies, Legislation, Control, Regulation, Water quality, Water pollution, Regulation, Water quality, Water pollution, Sewage treatment, Water quality control, Water resources, Bodies of water, Streams, Bacteria, Biochemical oxygen demand, Chemical oxygen demand, Outlets, Abatement, Legal aspects, law, Water purification, Water utilization, Permits, Waste disposal, Waste identification.

The Pollution Control Authority shall group designated waters into classes according to the best usage in the public interest. Standards of quality and purity shall be established for the different public use and benefit of such waters. The standards adopted may prescribe: (1) the extent of floating solids; (2) the extent of suspended solids; (3) the extent of bacteria allowed; (4) the extent of oxygen demand; (5) other properties of the water. In classifying the waters consideration shall be

given to the size, depth, rate of flow, use and present defilement of the waters, and the geophysical character and present use of the district border-ing such water. It shall be unlawful to pollute waters in contravention of the standards set by the Authority. Anyone desiring to make a new sewage outlet to discharge into any waters shall apply for and receive a permit from the Authority to do so. The Authority shall approve all plans for construction, addition to or change in any sewage or waste disposal system. If anyone can show it impossible to comply with the standards as to treatment of sewage, because no adequate method is known, the Authority shall withhold abatement orders for a period of not more than 5 years, such period being subject to extention. (Helwig-Fla) W69-08353

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS.

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources. For primary bibliographic entry see Field 5G

OPTIMAL TAXING FOR THE ABATEMENT OF

WATER POLLUTION, Carnegie-Mellon Univ., Pittsburgh, Pa. Jerome E. Hass.

PhD Dissertation, Carnegie-Mellon University, p 75-131, June 1969. 57 p, 11 tab, 49 ref.

Descriptors: *Taxes, *Optimization, *Economics, *Pollution abatement, Simulation analysis, Mathematical models, Pollutants, Water resources, Legal aspects, Political aspects, River basins. Identifiers: Miami River.

The problem of allocating the costs of maintaining river basin quality standards was examined. A mathematical model was developed for determining the minimum cost method of meeting stream quality standards when the Central Authority had no information regarding the waste treatment costs at each waste source. Taxes were found to be the best legal, political and economically justifiable tool. An algorithm was included in the analysis to determine the tax structure required for achieving a solution in a decentralized fashion. The net result was an operationally systematic method for a central water authority to follow in order to efficiently allocate assimilative capacity of the stream. Simulation techniques were employed. Using the model, taxes could also be levied, to yield optimal treatment configurations without knowing all the facts pertaining to treatment cost. (Thiuri-Cornell) W69-08547

THE ECONOMICS OF CLEAN WATER,

Scott Paper Co., Philadelphia, Pa. N. J. Lardieri.

Proc, Water Resources Seminars, 1967-1968, p 81-98, Univ Del, Newark, December 1968. 18 p, 11

Descriptors: *Economics, *Water resources, *Pollution abutement, *Cost-benefit analysis, *Mathematical models, *Optimization, Analog computers, Digital computers, Water quality control, Recreation, Delaware River.

Economic techniques for estimating costs for meeting federal water pollution control standards and potential for minimizing these costs based on the Delaware Estuary were presented. Cost benefit studies were conducted by municipal sources and estimates of recreation, fish and wildlife benefits expected from the improved level of water quality were made. Mathematical models employing both analog and digital computers were used for obtaining total costs of attaining water quality objectives under three different removal schemes namely uniform treatment, zonal approach and cost minimization. The summary of cost-benefit data pointed out that requiring uniform treatment from

Water Quality Control - Group 5G

all discharges is the most expensive of all solutions, that incremental benefits from higher water quality are negligible compared to the costs required to achieve them. (Thiuri-Cornell) W69-08548

RECHARGE WITH GROUNDWATER

TREATED MUNICIPAL EFFLUENT,
Texas Technological Coll. Lubbock. Water
Resources Center; and Texas Technological Coll., Lubbock. Dept. of Engineering.
For primary bibliographic entry see Field 05D. W69-08620

SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS,

Colorado Univ., Denver. Dept. of Microbiology. For primary bibliographic entry see Field 05D. W69-08622

5G. Water Quality Control

WATER POLLUTION CONTROL.

33 USCA secs 466, 466-1, 466-a, 466-b, 466c (Supp 1969).

Descriptors: *Federal government, *Water pollution control, *Water policy, *Pollution abatement, Abatement, Legislation, Water law, Legal aspects, Administrative agencies, Water quality control, Administration, Political aspects, State governments, Local governments, Financing, Water purification, Allotments, Economics, Grants, Model studies, Planning, Projects, Federal project policy, Project planning, Project purposes, Interstate com-

United States congressional policy contemplates the enhancement of the quality and value of our na-tional water resources through the prevention, control, and abatement of water pollution. It is also federal policy to recognize and preserve the primary responsibilities and rights of the states in preventing and controlling water pollution through aid to them in technical research, services and financing. Grants are available to state and local governments to assist in the development of projects which demonstrate new or improved methods of controlling the discharge into any waters of untreated sewage, and development of advanced waste treatment and water purification methods. waste treatment and water purification methods. The Secretary of the Department of Health, Education and Welfare is to prepare and develop comprehensive programs for eliminating or reducing the pollution of interstate waters and improvement of the sanitary condition of surface and underground waters. He is partially advised in these matters by the Federal Water Pollution Control Administration. The secretary promotes interstate cooperation with respect to uniform state laws, state compacts, research, experiments, and studies and may initiate investigations in a number of problem areas relating to water pollution. (Johnson-Fla) W69-08127

NEW ENGLAND INTERSTATE WATER POL-LUTION CONTROL COMPACT. Vt Stat Ann tit 10, secs 991-1002 (1958), as amended, (Supp 1968).

Descriptors: *Vermont, *Interstate compacts, *Water pollution control, *New England Interstate Descriptors: WPS Compact, New England, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, New York, Abatement, Interstate commissions, Interstate rivers, Interstate cooperatives, State governments, Water policy, Standards, Water quality, Water pollution, Classification, Tidal waters.

The states of New England join in this compact to abate and control pollution in their interstate waters. The compact shall apply to waters con-

tiguous to or flowing through two or more signatory states. Each signatory state shall be represented on the commission. The commission shall meet, conduct business, promulgate rules and make reports as required and as necessary for its purposes. commission shall be financed by the signatory states and its records subject to audit by each member. The commission shall establish physical, chemical and bacteriological standards of water quality for the various classifications of water. Each signatory state will classify its interstate waters by use, subject to approval by the commission. Each state pledges to abate pollution in interstate inland and tidal waters. Nothing herein shall prevent any signatory state from imposing additional restrictions to further reduce pollution in its waters. The commission may cooperate with New York in pollution abatement of common waterways. The compact was adopted by Vermont on June 29, 1951. (Helwig-Fla) W69-08151

LOCAL PROVISIONS. SC Code Ann secs 70-311 thru 70-491 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water districts, *Water distribution (Applied), *Cities, Boats, Lakes, River, High water mark, Low water mark, Swimming, Dams, Dikes, Canals, Reservoirs, Water conservation, Water control, Watercourses (Legal), Water resources development, Water pollution, Water pollution control, Water management (Applied), Water supply, Water wells, Public utilities, Wildlife, Domestic water, Easements. Identifiers: Penalties (Criminal), Life preservers, Motor boats.

Regulations are promulgated for boating in various waters of the state. The carrying of life preservers and the use of motor boats are regulated Authorization is given establishing several local water authorities. The authorities may construct reservoirs, dams, dikes, canals, tunnels, or whatever they deem necessary for the proper distribution of both domestic and industrial water. The terms and compensation of the authorities members are enumerated along with their specific powers. Among these are the powers to: (1) impound fresh water; (2) maintain water distribution systems; (3) protect the waters from pollution; (4) systems; (3) protect the waters from pollution, (4) lease, sell or convey land; (5) exercise the power of eminent domain and; (6) borrow money and issue negotiable bonds. The authority may charge reasonable rates for its services. Other provisions are made for local water districts, and regulations are made regarding water diversion and well digging. (Shevin-Fla) W69-08155

STATE BOARD OF HEALTH: WATER.

17 SC Code Ann 308-314 (1962).

Descriptors: *Water treatment, *South Carolina, *Domestic water, *Water quality control, Public health, Cities, Water supply, Engineering, Cesspools, Reservoirs, Water consumption, Water pollution, Chlorination, Chemical analysis, Bacteria, Biological treatment, Sewers, Flouridation, Construction, Pumping, Wells, Water works, Water sources, Tidal waters, Springs, Legislation. Identifiers: Savannah River Project.

Regulations are promulgated for the establishment of any waterworks that will furnish water for domestic use. All plans for building or improving water purification plants or altering the water source supply shall be submitted for approval to the State Board of Health. The application must pro-vide complete details of the proposals including estimates of the per capita consumption for the fu-ture and chemical and bacteriological analyses of the water source. Before being placed into service all new water distribution systems must be sterilized. The method of sterilization is set forth. No flourides may be added to the water supply unless approval is first obtained from the Board of Health. No water furnished for domestic use may contain impurities which may injuriously affect public health. Steps must be taken to amply protect the water sources from pollution. The area surrounding the Savannah River Project is designated an emergency area and is subject to certain special regulations in regards to water supply and sewage disposal. The tidal waters of the state are classified. (Shevin-Fla) W69-08166

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION).

41 111 2d 440, 243 NE2d 249-252 (1968).

Descriptors: *Illinois, *Pollution abatement, *Water policy, *Water pollution control, Abatement, Judicial decisions, Water pollution, Legislation, Administrative agencies, Water quality control, Legal aspects, Water law, Impaired water trol, Legal aspects, Water law, impaired water quality, Pollutant identification, Riparian rights, Water pollution effects, Public rights, Potable water, Water purification, Filtration, Financial analysis, Costs, Lake Michigan. Identifiers: *Injunctions.

PLAINTIFF, Metropolitan Sanitary District of Greater Chicago, was awarded a temporary injunction in the circuit court against defendant corporation restraining it 'from polluting waters of Lake Michigan by discharging any oil or oily substances into the waters' of the lake. The sanitary district alleged that such oil or oily substance was visibly floating on the surface of the lake. The circuit court found that an oil slick was coming out of the defendant's north slip into Calumet Harbor and covering an area of six thousand feet by fifty feet, but that the discharge was unintentional. In that court an expert witness testified that the slick, if continuously fed, would reach the intake of the south side water filtration plant of the city in a few days. If this occurred special filtration would be necessitated. The State Supreme Court in affirming the circuit court held that the statute, giving the district the power to prevent pollution of the sources of the city's water supply, gave authority for the district to get an injunction to prevent industrial pollution and that the statute was compatible with the federal statute relating to control of water pollution. (Johnson-Fla) W69-08172

A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.

Federal Water Pollution Control Administration, Washington, D. C. Research Committee. For primary bibliographic entry see Field 05D. W69-08199

ENVIRONMENTAL PRONUCLEAR APPLICATIONS, **PROTECTION** FOR

Harvard School of Public Health, Boston, Mass. Kresge Center for Environmental Health.
Dade W. Moeller, and Abraham S. Goldin.
ASCE Proc, J Sanit Eng Div, Vol 95, No SA3, Pap
6589, pp 373-385, June 1969. 13 p, 2 tab, 23 ref.

Descriptors: *Radioactive wastes, *Radioactive waste disposal, *Regulation, *Radiochemical analysis, Water pollution control, Water pollution sources, Abatement, Legislation, Standards, Monitoring, Pollutant identification.

Identifiers: Radioactive waste disposal standards.

Current environmental protection recommendations for nuclear applications are summarized and areas needing further research and development are reviewed in detail. Areas needing work are the improvement and simplification of surveillance, identification of pollutants, tracing of pollutants to their sources, application of standards, and

Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

development of counter measures for accidental releases. (KnappnUSGS) W69-08212

REGIONAL WATER QUALITY STANDARDS,

Delaware River Basin Commission, Trenton, N. J. Water Quality Branch.

Ralph Porges.

ASCE Proc, J Sant Eng Div, Vol 95, No SA3, Pap No 6596, pp 423-437, June 1969. 15 p, 7 fig, 10 ref.

Descriptors: *Standards, *Water quality, *Water quality act, *Delaware River, Streams, Estuaries, Water pollution sources, Water pollution control, Dissolved oxygen, Streamflow, Regulation, Water management (Applied), Waste Disposal, Water treatment

Identifiers: Delaware River Basin.

The Delaware River Basin encompasses many clean streams and a major pollution problem in the Water quality 85 mile long Delaware estuary. management concepts applied in the development of regional water quality standards included protection of clean streams, abatement of polluted waters, a minimum required degree of wastewater treatment, and the equitable apportionment of stream assimilative capacity. The Delaware River Basin Commission adopted water quality standards and regulations setting forth water uses to be protected, water quality criteria necessary to protect water uses, effluent quality requirements, and allocations of stream assimilative capacity. (Knapp-USGS) W69-08213

RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER,
California State Dept. of Public Health, Berkeley.

California State Dept. of Public Health, Berkele Bureau of Sanitary Engineering. For primary bibliographic entry see Field 05D. W69-08215

PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION,

Public Health Service, Rockville, Md. Div. of Environmental Health.

J. G. Terrill, Jr., C. L. Weaver, E. D. Howard, and J. M. Smith.

ASCE Proc, J Sanit Eng Div, Vol 95, No SA3, Pap No 6620, pp 545-561, June 1969, 17 p, 3 fig, 3 tab, 25 ref.

Descriptors: *Radioactive waste disposal, *Regulation, *Standards, *Water pollution sources, *Public health, Legislation, Environmental engineering, Radioactivity effects, Safety, Social aspects, Urbanization.

Identifiers: Reactor site selection, Public health considerations.

Factors of specific concern in the design and operating characteristics of nuclear plants to Federal, State, and local health agencies include physical and demographic site characteristics, potential air, water, land, and food contamination, land use, zoning, and exposure pathways. These factors must be considered to assure that the operation of one or more reactors at the selected site will not adversely affect the population and environment surrounding the plant. Research programs at operating power reactors are being coordinated to determine the methodology and analytical techniques required for an optimum surveillance program. The nuclear facility operator in cooperation with the State health agency should have a planned and rehearsed emergency plan which can be placed into effect to minimize adverse consequences in the event of an accident. (Knapp-W69-08216

SEWERAGE AUTHORITIES LAW.

NJSA secs 40:14A-2, 40:14A-6, 40:14A-20, 40:14A-28 (1967).

Descriptors: *New Jersey, *Pollution abatement, *Water pollution, *Treatment facilities, Legislation, Water pollution control, Public health, Water purification, Local governments, Waste treatment, Impoundments, Administrative agencies, Condemnation, Eminent domain, Public utilities. Identifiers: Service charges.

The purpose of this act is to relieve water pollution by all reasonable means in waters in or bordering the state. Counties and municipalities are authorized to construct and operate sewage treatment facilities and, if necessary, works for the impounding, transportation and release of water for the replenishment of waters diverted into a sewage facility. The sewage authorities are given the power of condemnation. (The discharge by municipalities, counties or persons of sewage which may cause pollution is prohibited.) The discharge of any matter which may be harmful to the sewage system or its efficient operation is prohibited. (Childs-Fla) W69-08313

STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC).

406 F 2d 170-176 (1st Cir 1969).

Descriptors: *Federal jurisdiction, *Thermal pollution, *Nuclear reactors, *Administrative agencies, Judicial decisions, Permits, Administrative decisions, Nuclear wastes, Water pollution sources, Electric power plants, Electric power industry, Water temperature, Heated water, Temperature control, Environmental engineering, Water pollution effects, Oxygen sag, Fishkill, Cooling towers. Identifiers: *Atomic Energy Commission.

Plaintiff sought review of an order of the Atomic Energy Commission of defendant's order which granted defendant a permit for the construction of a nuclear power reactor by several privately owned utility companies. New Hampshire argued that the operation of the reactor without a cooling tower facility would harm the natural resources of the Connecticut River by causing thermal pollution. The Atomic Energy Commission claimed that such evidence related to matters beyond its jurisdiction and granted the permit without considering the plaintiff's demands. The Commission held neither the Water Quality Act of 1965 nor Executive Order 11288 were applicable to reactors which the Commission did not own or operate. This court affirmed the Commission's order. No licensing by the Commission acts to relieve the licensee from complying with federal or state water pollution control regulations. Though the Atomic Energy Act refers repeatedly to the 'health and safety of the public,' it does not define these terms. This lack of definition and the legislative history of the act indicated that the terms health and safety had reference to radioactive hazards, not thermal pollution. (Blunt-Fla) W69-08316

PROTECTING WATER AND ICE SOURCES.

NH Rev Stat Ann secs 148:1 thru 148:37 (1964), as amended (Supp 1967).

Descriptors:"new Hampshire, *Public health, *Water supply, *Water quality control, Domestic water, Water pollution control, Legislation, Regulation, Adjudication procedure, Reservoirs, Lakes, Sewage treatment, Cities, Water analysis, Ice, Administrative agencies, Water sources, Ice fishing, Wells, Road construction, Water pollution, Drainage, Interstate rivers, Ponds, Surface waters. Identifiers: Injunctions (Mandatory), Penalties (Criminal),

The department of health and welfare, division of public health services, has authority over the public water and ice supply and the sewage systems of the cities. Regulations must be complied with when ice cutting for domestic use and of the domestic water supply. It is unlawful to pollute water used for public drinking purposes. The division may examine all water supplies to determine if they are suitable for public consumption and establish regulations necessary to protect the public health. The division may require such improvements in the water supply systems and sewage systems as it deems necessary for public health. It must approve construction plans for water supply systems and sewage systems. It may inspect emergency water sources and the valves which control the inflow of such water into the water supply. The division must approve plans to discharge pollution into the state's waters and it must see that all wells are properly fenced. (Shevin-Fla) W69-08348

PROTECTING WATER AND ICE SOURCES.

NH Rev Stat Ann secs 148:1 thru 148:14 (1964), as amended, (Supp 1967).

Descriptors: *Water supply, *Ice, *New Hampshire, *Public health, Water quality control, Domestic water, Cities, Regulation, Pollution abatement, Water pollution, Legislation, Lakes, Ponds, Reservoirs, Water wells, Rivers, Flourine, Boats, Fishing, Swimming, Sewage, Chemical analysis.

Identifiers: Penalties (Criminal), Injunctions.

A person placing any substance harmful to water in any pond or reservoir from which the city's water supply is taken is subject to fine and/or imprisonment. The board of health may remove the substance and charge the cost of such removal to the person who placed it there. A person willfully polluting the water or ice supply of any city may be fined and/or imprisoned. No person shall cut ice from any reservoir used as a public water supply unless first complying with local regulations regarding such cutting. No flourine shall be introduced into the public water supply unless a public hearing has first been held. Local boards may make rules in regard to fishing, boating and ice racing on lakes, ponds and reservoirs. No person shall bathe in waters protected for use as a public water supply. Any person injuring any property of the water company shall be subject to penalties. The board of health shall inspect areas from which ice is to be cut and determine if the sources of such supply may be deleterious to public health. Persons cutting ice from areas deemed polluted shall be subject to fine and/or imprisonment. The board may have any water supply analyzed to determine if it is safe for consumptive use. (Shevin-Fla)

PROTECTING WATER AND ICE SOURCES.

NH Rev Stat Ann secs 148:15 thru 148:25a (1964), as amended (Supp 1967).

Descriptors: *New Hampshire, *Public health, *Water sources, *Water quality, Legislation, Water supply, Ice, Water pollution, Regulation, Interstate rivers, Lakes, Ponds, Reservoirs, Drainage, Wells, Cities, Water quality control, Sewage treatment, Adjudication procedure, Surface waters, Chlorination, Sewage systems, Road construction, Sewers.

When it is believed that a public water supply is contaminated and local regulations will not be sufficient to abate the condition, a petition may be filed with the Department of Health and Welfare to investigate the situation and make necessary regulations. Any regulations so promulgated shall be in force after due notice is given. The department may make regulations for the protection of interstate waters used as a source of public drinking water by adjoining states. The department may prohibit the use of certain wells, springs or other

sources of water from being used as a source of domestic water if it finds such source to be polluted. The department may examine the conditions of all water supply sources and sewage systems and require that certain improvements be made to insure adequate protection of public health. All public water supply systems must be provided with disinfection facilities. Any person constructing a water supply or sewage system must submit his plans to the department for approval. No highway shall transverse an area used for storage of public drinking water without the approval of the department. (Shevin-Fla) W69-08350

PROTECTING WATER AND ICE SOURCES. NH Rev Stat Ann secs 148:26 thru 148:37 (1964), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Water sources, *Water quality, *Water supply, Water quality control, Valves, Flow control, Regulation, Public health, Intakes, Water pollution, Sewage, Streams, Lakes, Ponds, Rivers, Water pollution control, Wells, Adjudication procedure, Administrative

agencies, Legislation. Identifiers: Emergency water sources, Emergency water supply, Penalties (Criminal).

No person, supplying water to the public for domestic use, may maintain a connection through which water may be received from an auxiliary source, unless such source has been approved by the division of public health services. Every valve, or other device for controlling the inflow of water of an unapproved character to the public supply pipe system must be of such construction to permit efficient inspection, and must be inspected at least twice annually. All valves used in connection with sources maintained for fire protection shall be subject to the seal of the division and whenever such seal is broken the division must be notified within 24 hours. The division may order the abandonment of emergency sources when deemed necessary for the public health. No person shall discharge sewage into the waters of the state without first receiving approval of the plans for the discharge by the department of health. No wells may be maintained unless they are sufficiently protected by fencing so constructed that no child can crawl through or under it. (Shevin-Fla) W69-08351

POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA.

SC Code Ann secs 70-101 thru 70-111 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water pollution control, *Pollution abatement, *Administrative agencies, Air pollution, Water pollution, Water agencies, Air pollution, Water pollution, Water pollution effects, Water pollution treatment, Sewage, Sewage treatment, Regulation, Legislation, Water quality, Federal government, State governments, Legal aspects, Water utilization, Water purification, Standards, Public health, Public benefits, Conservation, Streams, Fish, Wildlife, Waste disposal, Projects, Federal project policy

Identifiers: *Federal Water Pollution Control Act.

It is the policy of the state that reasonable standards of purity of the waters be maintained consistent with public health, public enjoyment, protection of fish and wildlife and operation of industry. Reasonable methods of pollution prevention and control shall be used. The Pollution Control Authority is created to abate and control the pollution of state waters and air. The authority adopt rules toward this goal and shall set standards of purity for all streams. The Authority shall have the power to safeguard the waters and air from pollution; control sewage discharge; institute actions to compel compliance with this act; issue permits for discharge of wastes; cooperate with the federal or other state governments regarding pollution

control; conduct studies and research regarding pollution; develop a comprehensive program of pollution abatement; approve plans for waste disposal system; approve projects for loans under the Federal Water Pollution Control Act; participate in proceedings under the Federal Water Pollution Control Act; consent, on behalf of the state, to requests by the federal government for bringing suit for abatement of pollution. The Authority shall do all acts necessary to secure the benefits of the federal act. (Helwig-Fla)

OF POISONING. ETC.. POLLUTION, STREAMS; DYNAMITING.

SC Code Ann secs 28-671 through 28-677, (1962).

Descriptors: *South Carolina, *Explosives, *Pollutants, *Poisons, Water pollution control, Water pollution sources, Fish, Fishkill, Fish toxins, Fish conservation, Shellfish, Legislation, Legal aspects, Fishing, Streams, Lakes, Rivers, Boats, Inland waterways, Public benefits, Electrical shocking

Identifiers: Dynamiting.

ruthers-Fla) W69-08366

It shall be unlawful for any person to cause poison or any other deleterious matter to enter any fresh or salt water of the state frequented by game fish, in a quantity sufficient to kill or stupefy any such fish of shellfish. The captain of any ship shall be responsible for any discharge of such substances from his vessel. Violators will be subject to fine and/or imprisonment. It is unlawful to poison the waters of the state in any manner for the purpose of taking fish. If any person casts impurities, poisonous to fish, into the waters of this state he shall be subject to fine or imprisonment. It shall be unlawful for any person to use explosives to take fish or to aid anyone else in doing the same or to possess such explo-sives on any vessel usually used for fresh-water fishing. Violators shall be guilty of a misdemeanor. If any person is found picking up fish within 2 hours after an explosion, it shall be deemed prima facie evidence of a violation of the above. Any person convicted of using explosives shall be prohibited from hunting or fishing within the state for 5 years. Anyone failing to report dynamiting used to unlawfully take fish within 2 weeks the state for the state for the state for the state fish within 2 weeks the state fish withi fully take fish within 2 weeks thereafter shall be guilty of a misdemeanor. Informer's shall not be subject to prosecution for slander or malicious prosecution or subject to civil action for damages to the person so accused of using explosives. (Car-

MISCELLANEOUS PROVISIONS (UNLAWFUL DISCHARGE OF OIL IN CHARLESTON HAR-BOR).

SC Code Ann secs 54-451 thru 54-458 (1962).

Descriptors: *South Carolina, *Harbors, *Oily water, *Docks, Ships, Pollution abatement, Pollu-tants, Legislation, Regulation, State governments, Damages, Rates, Salaries, Ships, Boats, Navigation, Transportation, Navigable waters. Identifiers: Penalties, Liens, Wharfingers.

Charleston is declared to be the State port of South Carolina. To discharge oil from any vessel while within a harbor of this state is unlawful. Violation of this provision is punishable by fine not exceeding \$500 which shall become a lien upon such vessel. It shall be unlawful to discharge oil any place within this state from which it shall drain into a harbor in any county containing a city with more than 60,000 population. Violation is punishable by fine not exceeding \$500 and/or imprisonment not exceeding 6 months. If any person is injured through the mismanagement or negligence of the person in charge of a steamboat, the person in charge shall be punished by fine and/or imprisonment. Beaufort County shall build wharves at Buchingham Ferry and Jenkins Island to permit the docking of steam-boats. Wharfingers shall be appointed at such

wharves. Their salaries shall be paid from funds collected from boats docking at such wharves. (Ka-W69-08373

CRUSHED LIMESTONE BARRIERS: A BASIC FEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources. R. Rupert Kountz, Robert E. Jarrett, and Alan F.

Resources, Research on Land and Water Resources, Research Project Partial Technical Completion Report, University Park, Pa., June 1969, 3 p, 1 ref. OWRR A-002-PA.

Descriptors: *Limestones, *Barriers, *Neutraliza-tion, *Acidic water, Mine drainage, Chemical reac-tion, Flow rates, Hydraulic models, Backwater, Coal mine wastes.

This project revealed that crushed limestone barriers can be used in streams contaminated with acid mine drainage to reduce the acidity in the water. Studies were limited to acidity concentrations less than 1,000 mg/1. Ferrous ion does not interfere with the neutralization process. However, ferric ion does interfere with it and will eventually render the limestone impotent because of a surface coating of iron oxide. Hydraulic model studies of barriers provided data on backwater depth, flow surfaces, flow rates, barrier lengths, and stone sizes. These studies indicated a barrier installation could have any reasonable number of units and be of such stone size as to be compatible with the site topography. The Commonwealth of Pennsylvania is constructing a prototype barrier installation based on the data developed in this project. (Pollard-Penn State W69-08376

BIOLOGICAL OXIDATION RATES IN MINE

ACID WATER REGIMES,
Pennsylvania State Univ., University Park. Inst. for
Research on Land and Water Resources. R. Rupert Kountz, Lee Rosenberger, and W. A. Eberhardt.

Institute for Research on Land and Water Resources, Research Project Technical Completion Report, University Park, Pa., June 1969, 28 p, 25 ref, 4 tab, 7 fig, 1 append. OWRR A-001-PA.

Descriptors: *Biological treatment, *Mine wastes, *Self-purification, *Acid streams, Water purification, Iron, Organic wastes, Aerobic conditions. Identifiers: *Velocity constants, Streeter-Phelps.

The velocity rate constants for biological oxidation were evaluated by employing synthetic sewage and laboratory simulated acid mine water regimes. Lowering of pH decreases the value of the rate constants until a maximum reduction of 65 percent is obtained at pH value of 4.0. Increasing concentrations of ferric ion cause a further, but small decrease in the rate constant. It was demonstrated that biological oxidation does occur in streams contaminated with acid mine drainage; consequently, the permissable discharge loadings can be calculated (by employing the reduced rate constants) either by manual computation, or the stream stretch can be developed with an analog computer programming. (Pollard-Penn State Univ) W69-08379

WATER USE AND RELATED COSTS WITH COOLING TOWERS,

Illinois State Water Survey, Urbana, Ill. Brian Berg, Russell W. Lane, and Thurston E. Larson

Journal of the American Water Works Association, Vol 56, No 3, pp 311-328, March 1964. 18 p, 9 fig, 5 tab, 10 ref.

Descriptors: *Cooling towers, *Water cooling, Economics, Water treatment.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Identifiers: Once-through-cooling, Cooling tower concentration, Makenup water.

The authors made an economic evaluation of cooling towers for water reuse compared with oncethrough use. The location used in this report is northeastern Illinois. The report presents a method in which the approximate costs for specific coolingtower applications may be estimated and compared with the costs of nonconservative practices. Chemical savings could be realized if mineral concentrations in the cycled cooling water were increased 5 to 10 times. In the refrigeration industry, evaporative, or air-cooled condensers are quite often economically competitive with the smaller cooling towers (10-100 tons). For maximum economy, optimum size match is desired between the equipment to be cooled and the heat dissipation equipment. Due to this, a competent engineer should be hired to study the specific cooling needs in detail. It is suggested that if the cost of both once-through and conservation equipment are within 30 percent of each other, there should be a thorough investigation. (Ross-Vanderbilt) W69-08407

CHINKING UP SOME CRACKS,

Federal Water Pollution Control Administration, Washington, D. C. Div. of Technical Control. For primary bibliographic entry see Field 06A W69-08539

WATER POLLUTION CONTROL IN THE TEX-

TILE INDUSTRY, American Textile Manufactures Inst., Charlotte, N. C.; and Burlington Industries, Inc., Greensboro, N.

R. W. Armstrong, and D. Byrd.

Textile Chemist and Colorist Vol 1, No 6, p 142/21-145/24, March 12, 1969. Based on a symposium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce

Descriptors: Water pollution control, *Water pollution sources, Water pollution treatment, Biochemical oxygen demand. Identifiers: *Textile wastes.

In the last ten years, the textile industry has made great strides in cleaning up waste waters. This massive campaign was initiated in order to comply with federal and state regulations concerning the pollution of our nations rivers and lakes. Although great progress has been made in this field, the textile industry is still subject to much criticism from small newspapers, radio and television. These charges, which are often false, have been leveled because of the textile industries poor history concerning the pollution of streams. In order to build a clean image, the industry must clean-up America's waterways and then must establish good public relations with the news media to inform the public of the work which is being done to solve the pollution problem. (Goodwin-NC State Univ) W69-08552

THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A PLANT SITE,

Lockwood Greene Engineers, Inc., Spartanburg, S.

Textile Chemist and Colorist, Vol 1, No 7, p 185/40-187/44, March 26, 1969. Based on a sym-posium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior.

Descriptors: *Economics, *Treatment facilities, *Sites, Flow rates.

This article discusses the aspects which should be considered when picking a plant site. The geographic location influences the need for weather protection and design of mill. The topography has a bearing on the cost of operation and development.

The surrounding industries and communities should also be investigated to insure that there is no major conflicts over waste disposal. The existing utilities and capacity to deliver necessary power, chemicals and water should be investigated. Finally, stream flow rates and other mandatory requirements should be studied. (Goodwin-NC State Univ) W69-08553

WATER QUALITY MANAGEMENT IN VIR-

GINIA, Virginia Water Control BOARD, Richmond, Va. A. H. Paessler.

Textile Chemists and Colorist, Vol 1, No 7, p 181/35-184/38, March 26, 1969. Based on a symposium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior.

Descriptors: *Dissolved oxygen, *Standards, *Water quality, *Water temperature, *Water *Water quality, *Water temperature, *Water quality control, *Water management (Applied), Sampling, Nutrients, Analysis, Flow rates.

The Virginia State Water Control Board administrative set-up is described and compared with water quality management agencies in other states. In order for such an organization to function, it was necessary to establish standards for water quality. These were published in the water quality act of 1965 and in the so-called anti-degradation statement. The chief index to water quality is temperature with the dissolved oxygen content being the second most important standard. The effect of low flow rates is discussed. The three methods of water quality management programs - (1) stream sampling, (2) sample analyses and (3) data storage, processing and retrieval are discussed in detail. However, problems such as nutrient enrichment and land run-off or natural pollution remain unsolved. (Goodwin-NC State Univ) W69-08554

FEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS,

Federal Water Pollution Control Administration, Washington, D. C

W. J. Lacy, and A. Cywin. Based on a symposium, February 16-18, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior. Textile Chemist and Colorist, Vol 1 No 7, pp 173/25-176/28, March 26, 1960

Descriptors: *Water pollution control, *Water Quality Act, *Legislation, Standards, Industrial

Identifiers: Textile wastes, Industrial grant pro-

The history and research and development program of the Federal Water Pollution Control Administration are given. Grant acquisition procedures of federal monies through F.W.P.C.A. are described. Examples of industrial grants made are provided. The nature of textile wastes and the need for treatment of these wastes are discussed. (Livengood-N C State Univ) W69-08555

BETTER MANAGEMENT OF WATER RESOURCES IS A MUST IF FUTURE NEEDS ARE TO BE MET,

Department of Commerce, Washington, D. C. K. L. Kollar.

Based on a symposium, February 26-28, 1969, sponsored by A.A.T.C.C. and US Departments of Commerce and Interior. Textile Chemist and Colorist, Vol 1, No 7, pp 173/25-176/28, March 16, 1040

Descriptors: *Water quality, *Water Resources Planning Act, *Water shortage, *Water resources, Standards, Economics.

A growing population and expanding economy require that water quality control be maintained at a level making multiple reuse possible. Congress has established a Water Resources Council to determine National Water needs and plan development of the Nations' major river basins. Results of a Bureau of the Census canvas on the withdrawal and use of water in textile manufacture for 1954, 1959, and 1964 are summarized. Increased concern about water quality by the industry is indicated. (Livengood-N C State Univ) W69-08557

06. WATER RESOURCES **PLANNING**

6A. Techniques of Planning

APPLICATION OF COMPUTERIZED OPERA-TIONS RESEARCH TECHNIQUE FOR OP-TIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER PROJECT,

California State Dept. of Water Resources. Ad-

vanced Techniques Section. Gary S. Risch.

Ody S. Risch.
Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 268-279, 1968. 12 p, 2 fig, 5 tab, 4 ref.

Descriptors: *Operations research, *Systems analysis, Computer programs, Synthetic hydrology, Linear programming, Dynamic programming, Oprimization, Economics, Cost-benefit analysis, Reservoir operation, Planning, Streamflow forecasting, Water supply, Water yield. Identifiers: Eel River (Calif).

The difficulty of the economic analysis of hydrologic projects usually increases exponentially as the number of system components increases. Conventional methods of developing graphs, charts, and curves are being replaced, or at least supplemented, by new operations research techniques, such as linear and dynamic programming. These techniques will aid the planner in analyzing hydrolegic and economic problems and in praying hydrologic and economic problems and in providing an optimum economic solution with much less effort than expended using conventional methods. Planning for development of the Eel River, involving 3 potential reservoirs and a connecting tunnel, has given us the opportunity to test these new techniques on a medium sized project. This paper illustrates how the computer model could be formulated for both linear and dynamic programming solutions to this sizing problem. Very little knowledge of the linear programming theory is necessary to make use of that technique; however, an illustration of the dynamic programming theory is presented to clarify the dynamic programming solution methodology. (Knapp-USGS) W69-08240

A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING,

Technion - Israel Inst. of Tech., Haifa. Lowdermilk Faculty of Agricultural Engineering. Nathan Buras, and Theodore Herman

Technion, Israel Inst Tech Progr Rep No 2, July 1968. 131 p, 21 fig, 95 ref.

Descriptors: *Systems analysis, *Optimization, *Water resources development, Water management (Applied), Computers, Computer programs, Dynamic programming, Linear programming, Estimating, Surveys, Management, Operations research, Queueing theory, Optimum development plans, Stochastic processes, Synthetic hydrology, Model studies.

Identifiers: *Water resources engineering, *Israel.

The progress of Technion, Israel in using systems analysis in solving water resources development and management problems is discussed. A Wide variety of analytical methods were applied in the

Techniques of Planning—Group 6A

design of water resource systems. Most of them, however, pointed out the necessity of setting up stochastic sequential models, as the best approximations to the real situation. Dynamic programming seems to fill this need, with its variations and adaptations. However, the effectiveness of dynamic programming is limited by the computational difficulties. The conjunctive development and utilization of surface storage and groundwater aquifers, especially in semi-arid regions, were successfully analyzed through dynamic programming. Beginning with rather simple models, the analysis progressed to include stochastic inflows serially correlated, and more specific aquifer-oriented problems. One such model touched upon the important problem of optimal exploitation of a coastal aquifer, where the salt water-fresh water interface has an important role. Another model analyzed in great detail the behaviour of an aquifer, which has to satisfy certain demands for water and which is connected to the surface storage subsystem through its recharge facilities. Markov chain theory was applied also the derivation of operating rules for multistructure systems, as well as to the analysis of problems connected with pollution transport in streams. Linearized models of water resource systems have been used also in the design and operation of surface reservoirs. (Knapp-W69-08251

AN INVENTORY OF PROBLEMS IN WATER

RESOURCES ENGINEERING, Technion - Israel Inst. of Tech., Haifa. Lowdermilk Faculty of Agricultural Engineering. Nathan Buras.

Technion, Israel Inst Tech Progr Rep No 1, Oct 1967. 42 p, 4 fig, 61 ref.

Descriptors: *Systems analysis, *Optimization, *Water resources development, Water management (Applied), Computers, Computer programs, Dynamic programming, Estimating, Surveys, Data collections, Management, Operations research, Optimum development plants, Stochastic Optimum development plants, Stochasti processes, Synthetic hydrology. Identifiers: *Water resources engineering, *Israel.

Water resources engineering uses the techniques of systems analysis in solving national water resource problems. Research in this field in Israel includes a review of the major problems of the engineer, evaluation of the operations research techniques needed, and study of the application of dynamic programming to analysis of water programs. The problems of data collection, economic evaluation, sociology, economics, management, urbanization. and operating policy in Israel are outlined and suggestions for research leading to their solution are given. (Knapp-USGS) W69-08256

THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS,

Stanford Univ., Calif. Dept. of Civil Engineering. For primary bibliographic entry see Field 06B.

REVIEW OF SURFACE WATER SYSTEMS

ANALYSIS, Survey, Arlington, Va. Water Geological Resources Div.

N. C. Matalas. Proc, Nat Symp Anal Water Resource Syst, p 270-277, Denver, July 1968. 8 p, 20 ref.

Descriptors: *Systems analysis, *Design, *Optimization, *Planning, *Water resources, Simulation analysis, Economics, Hydrology, Engineering,

Synthetic hydrology.

The role of systems analysis in the design of optimal water resource systems was discussed. Previously the planning process had been largely in the domain of engineering and hydrology. Economics

had been treated as an incidental matter to be considered at the end of a project in an effort to justify it. The methodology of systems analysis had been introduced in the past decade and economics had become an integral part, along with engineering and hydrology, of the planning of water resource development. The design of water resource system, be it single or multiple, was subject to alternative plans. The use of benefit-cost analysis, optimization and simulation techniques and of synthetic hydrology for optimal water resource systems planning was considered. (Thiuri-Cornell) W69-08533

OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORA-

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab. For primary bibliographic entry see Field 05D. W69-08534

AN APPLICATION OF NON-LINEAR PROGRAMMING TO THE PLANNING OF MUNICIPAL WATER SUPPLY SYSTEMS: SOME RESULTS,

Harvard Univ., Cambridge, Mass. Harvard Water Program.

Clifford S. Russell.

Proc, Nat Symp Anal Water Resource Syst, pp 309-314, Denver, July 1968. 5 p, 1 tab, 1 fig, 6 ref

Descriptors: *Optimization, *Planning, *Municipal water, *Water supply, *Model studies, Timing, Size, Systems analysis, Mathematical models, Interest rate, Economies of scale. Identifiers: Rules of thumb.

A non-linear programming model was developed and used to analyze water systems for the purpose of generating 'optimal rules of thumb' for the use in the practical planning of Municipal water supply. The analysis included the time path of water system development showing periods of optimality, adequacy and inadequacy, the framework of the model, implications for practical planning, timing and optimal size. It appeared that the optimal size was relatively constant over time when the interest rate was low and/or economies of scale were important, but that the size increased significantly with time when the interest rate was large and economies of scale unimportant. The results obtained pointed to a promising method of harnessing the technique of mathematical programming for the benefit of practical planners. Calculations for the required ranges of key parameters could in principle be done at a central location, and the results made available in the form of size and timing handbook rules. A sample of the handbook tables for optimal rules of thumb was presented. (Thiuri-Cornell)

OF LINEAR APPLICATION AN APPLICATION OF LINEAK PROGRAMMING TO EFFICIENCY IN OPERATION OF A SYSTEM OF DAMS,
Raytheon Co., Waltham, Mass. For primary bibliographic entry see Field 04A. W69-08536

ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS, Water Resources Engineers, Inc., Walnut Creek,

For primary bibliographic entry see Field 02L.

W69-08537

CHINKING UP SOME CRACKS,

Federal Water Pollution Control Administration, Washington, D. C. Div. of Technical Control. G. K. Young.

Proc, Nat Symp Anal Water Resource Syst, pp 289-297, Denver, July 1968. 9 p, 1 tab, 3 fig, 10 ref.

Descriptors: *Surface water, *Planning, *Pollution abatement, *Dynamic programming, *Monte Carlo Method, *Risks, Computer programs, Control systems, Economics, Water resources, Hydrologic systems, Reservoir operation, River systems, Decision making. Identifiers: Kanawha River.

Two studies on surface water were discussed. The first discussion provided case study information which compared relative importance of hydrologic uncertainties versus uncertainties in economic and engineering parameters. The second discussion involved computational aspects of the Monte Carlo Dynamic Program for solving reservoir operation problems. For the first study an analysis of pollution control systems on the Kanawha River was made. The Kanawha River study provided the background on the importance of the various phases of the problem. The use of the Monte Carlo Dynamic Programming technique aided in the selection of computational procedures which provided useful information for decision-making on the final commitment of time and money in any systems analysis study. It was concluded that hydrologic uncertainties are less important than other engineering and economic uncertainties.

Waste loading and the other engineering and economic factors appeared to contribute greater uncertainty to planning decisions than hydrologic factors. (Thiuri-Cornell) W69-08539

OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES SYSTEM, California Univ., Los Angeles. Water Resources

Center

W. A. Hall, R. W. Shepard, W. S. Butcher, A. M. Esogbue, and S. C. Parikh.

Water Resources Center, Univ. of Calif., Contrib, No 22, p 1-75, October 1967. 75 p, 8 fig, 11 charts, 14 ref.

Descriptors: *Mathematical models, *Dynamic programming, *Linear programming, *Financial feasibility, California, Optimization, Multiple purpose, Economics, Planning, Energy, Reservoirs, River basins, Water resources development. Identifiers: Sacramento Basin.

A mathematical model for planning optimal operating policy for a deterministic 10-year critical period hydrology was developed and applied to a multipurpose water resource system involving a multireservoir and a multichannel development. The objective of the study was to maximize financial feasibility for planning purposes based on deliveries of firm energy, firm water, off-peak energy and off-season water. The combined water resource projects in the Sacramento Basin were studied. The analysis provided for the specification of the values of firm energy, firm water, dump energy and dump water produced in the critical period and specified for the volume of water to be pumped back for energy storage purposes. The whole system was decomposed into a 'master wholesaler' 'individual producer' relationship. Using dynamic and linear programming techniques the reservoir operators and the master maximize returns, the former for individual reservoir, the latter for the whole system. The analysis emphasized the advantages of system operation as compared to individual project operation. (Thiuri-Cornell) W69-08540

MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE SYSTEMS,

Battelle-Northwest, Richland, Wash.

James P. Heaney.
Proc, Nat Symp Anal Water Resource Syst, p 231-240, Denver, July 1968. 10 p, 3 fig, 16 ref

Descriptors: *Resource allocation, *Linear programming, *Dynamic programming, *Optimization, *Constraints, *Regional analysis, Tangible benefits, Intangible benefits, Planning, Basins, Mathematical models.

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

Identifiers: *The Colorado River Basin.

Linear programming and dynamic programming techniques were applied to the Colorado River Basin to achieve an optimal allocation of its water resources. Both tangible and intangible benefits were considered. It was assumed that the objective function was to maximize regional net benefits sub-ject to the overall regional and individual-studyarea constraints. In addition, individual areas sought to maximize their benefits subject to their area constraints. The mathematical programming nodel developed, offered quantitative techniques for evaluating interdependencies that are of prime concern for regional analysis. It was concluded that the rigid 'requirements' concept ignored the fact that water-resource can be allocated efficiently under competitive economic conditions, and caused water supply systems to be expanded, often at high cost, in order to artificially keep the imat high cost, in order to arthritary keep the imputed water value equal to zero. A strong argument for allocating water resources efficiently under competitive economic conditions was provided. (Thiuri-Cornell) W69-08541

A FIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM,

Massachusetts Inst. of Tech., Cambridge.

Bruce Blanchard

Unpublished, Master's, Thesis, Civil Eng, August 1964, 100 p.

Descriptors: *Linear programming, *Optimization, *Design, *River basins, *Hydrologic data, Economics, Simulation analysis, Planning, Water resources, Constraints. Identifiers: Sensitivity analysis.

A linear programming model was used as a first trial in optimal design of a river basin system. Sensitivity analysis techniques were applied to the linear programming model to examine the effect of errors in hydrologic and economic data and effects of changes in constraints. Results showed that a linear programming model could be used to reduce the number and the range of variables to be used in simulation studies of the basin, as well as, to point out areas of resource allocation in future planning studies. It was found that linear programming (with its considerable limitations) could be an effective technique for a first estimate of the optimal design and operation of a complex water resource system. (Thiuri-Cornell) W69-08544

STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK,

Nevada Univ., Reno. Center for Water Resources Research.

William S. Butcher.

Proc, Nat Symp Anal Water Resource Syst, p 315-320, Denver, July 1968. 6 p, 7 ref.

Descriptors: *Stochastic processes, *Risks, *Dynamic programming, *Water resources, *Optimization, Mathematical models, Markov timization, Mathematical models, Markov processes, Probability, Decision making, Reser-

The objectives of water resources development, the role that risk plays in choosing these objectives, and the use of stochastic dynamic programming to assess risk in a certain limited number of water resource problems were discussed. Conventional analysis of water resources tended to ignore risk. yet in fact, risk was present and individuals had dif-ferent assessment of its value placed on expectation of returns. By employing a mathematical model based on the Markov chain technique, the use of stochastic dynamic programming technique for as-sessing risk and uncertainty involved in making optimal policy decisions was presented. Stochastic dynamic programming is suggested as a means for coming to grips with some of the elements of risk that were not possible to assess by conventional reservoir operation studies. (Thiuri-Cornell) W69-08546

INDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MUL-TERS BY DECOMPOSITILEVEL OPTIMIZATION,

California Univ., Los Angeles. Dept. of Engineer-

For primary bibliographic entry see Field 02F. W69-08550

6B. Evaluation Process

WATER RESOURCE CON-MISSISSIPPI FERENCE - 1969.
Mississippi State Univ., State College. Water

Resources Research Inst. For primary bibliographic entry see Field 02E. W69-08221

AN INVENTORY OF PROBLEMS IN WATER

RESOURCES ENGINEERING, Technion - Israel Inst. of Tech., Haifa. Lowdermilk Faculty of Agricultural Engineering. For primary bibliographic entry see Field 06A. W69-08256

FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON RE REPORT NO 1, REQUIREMENTS REGION. AMD SOURCES.

Metropolitan Washington Council of Governments, D. C. For primary bibliographic entry see Field 06D. W69-08257

THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS.

Stanford Univ., Calif. Dept. of Civil Engineering. Stanford Univ Eng-Econ Proj Rep No EEP-7, Aug 1963. 115 p, 32 fig, 8 tab, 23 ref.

Descriptors: *Cost-benefit analysis, *Project planning, *Risks, *Water resources development, Economics, Management, Statistical methods, Forecasting, PLANNING, Systems analysis. Identifiers: *Uncertainty analysis.

Estimates of benefits and cost of water resources development are contingent upon numerous as-sumptions for the future and are subject to uncertainty. Since a single-valued benefit-cost ratio is used as a criterion for determining the economic value of a project and for relative ranking of projects, a measure of the uncertainty of the benefitjects, a measure of the uncertainty of the benefit-cost ratio was found necessary to determine if the funds invested in water projects are truly as productive as claimed. The degree of uncertainty of preliminary cost and benefit estimates was studied to allow the uncertainty of the estimates to be included in the economic evaluation of projects. It was found that cost estimates are undervalued an average of 75% below actual costs, and median cost estimates are undervalued 30% below actual costs, after adjustment of the actual costs for construction price trends, changes in project planning, structural and engineering modifications and national emergency. The undervaluation of costs is even greater before the adjustments. Lognormal distribution functions were found applicable to the ratios of actual to estimated costs and their parameters were computed for the various classes of cost ratios. It was found that the average annual benefits are on the average overestimated. The overestimation was found to increase with the length of the project lifetime and to decrease with the discount rate. A SAMPLE CALCULATION AND Fortran program listing are included. (K-napp-USGS) W69-08266

NORTH AMERICAN WATER PROBLEMS AND THEIR SOLUTION, SUPPLY American Bar Association, Chicago, Ill. Henry P. Caulfield, Jr.

ABA Section of Mineral and Natural Resources Law (1966 Proceedings), p 15-20, 1966. 6p

Descriptors: *Water Resources Planning Act, *Water resources development, *River basin commissions, River basin development, Interbasin transfers, Federal government, State governments, Local governments, Water quality, Water utilization, Water policy, Administration, Legislation, Estimating, Long-term planning, Planning, Estimating, Long-term planning, Planning, Cooperation, Water allocation (Policy), Water

supply, Water pollution control. Identifiers: Federal-state cooperation, Water resources council.

The structure and objectives of the Water Resources Planning Act are discussed. Title I of the act sets up a Water Resources Council whose functions are to make a national assessment of water conditions, to establish a national pattern of federal water policy, to create federal-state river basin commissions under Title II and to make 50% grants to the states for comprehensive water resources planning. Title II establishes federal-state commissions in order to provide for a collaborative system of water planning among federal, state and local governments. Such interaction is necessary since each government has separate responsibilities. The local governments are concerned chiefly with industrial and municipal supply while states are concerned with health and pollution measures. The federal government is involved in establishing comprehensive and long-range programs and in aiding with financing and providing technical personnel. The commissions are planning bodies with legislative powers left in Congress and the various state legislatures. (Kahle-Fla) W69-08380

SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES FIELD,

New Mexico Univ., Albuquerque. Blair T. Bower. Natural Resources Journal, Vol 5, No 2, p 286-297, Oct, 1965. 12 p, 6 ref.

Descriptors: *Administration, *Planning, Low flow augmentation, Water quality control, Land use, Water supply, Waste disposal. Identifiers: *Research needs, Accuracy of data,

Uncertainty, Institutional aspects.

The article discusses research that will pay off in improved water resources planning and management. The first problem is handling uncertainty. Three procedures for handling uncertainty are described, all of which emphasize that planning must be carried on continuously. Related to the un-certainty problem is the relative accuracy of data used in water resources planning. Planning is insufficiently related to the precision of the data; studies are needed that relate various levels of precision to different types of water resources systems. Institutional problems are discussed. Techniques need to be devised by which the decisions of private and local governmental units can be integrated with the planning and operating decisions of federal and state agencies. There are a range of problems relating to development of operating procedures for water resources systems. The author substitutes 'water quality improvement' for the less useful phrase 'low flow augmentation,' and recommends that water quality improvement benefit functions related to water quality parameters be developed. Finally, spatial patterns of land use and water supply are considered in relationship to metropolitan waste disposal facilities. (Gossen-Chicago) W69-08381

RESEARCH ON COMPREHENSIVE PLANNING OF WATER-RESOURCE SYSTEMS, North Carolina Univ., Chapel Hill.

Maynard M. Hufschmidt. Natural Resources Journal, Vol 5, No 2, p 223-235, Oct, 1965. 13 p, 36 ref.

Descriptors: *Planning, Technology, Legal aspects, Inter-agency cooperation, Alternative costs, Economic prediction, Input-output analysis, Systems analysis.

Identifiers: *Research needs, Social science, Planning regions, Benefit functions.

This paper discusses research needs in comprehensive water-resource planning. Research topics are presented under three headings corresponding to three major steps of the planning process: (1) establishing the objectives of design; (2) translating objectives into design criteria; and (3) designing the system, through use of the design criteria, for maximum realization of the objectives. Classifying research in this way emphasizes research problems involving the relationship between social science and technology. Two research problems are involved in stating objectives. One is to determine whether the federal legislature can express objectives in forms useful for field-level planners. The second, involving situations where federal, state, and local agencies all participate in planning, is to clarify whose objectives are to govern. Translating objectives into criteria involves the following questions: roles of various agencies in deriving standards and criteria; consideration of alternative cost instead of benefits; and definition of appropriate planning regions. Systems design requires research on: techniques for regional economic projections; derivation of benefit functions; deriving the input-output relationships; preliminary screening techniques for system design; systems analysis techniques; and the system design process as a whole. (Gossen-Chicago)
W69-08382

FUTURE ECONOMICS RESEARCH ON WESTERN WATER RESOURCES -- WITH PAR-TICULAR REFERENCE TO CALIFORNIA, North Carolina State Univ., Raleigh.

G. S. Tolley. Natural Resources Journal, Vol 5, No 2, p 259-285, Oct, 1965. 35 p, 46 ref.

Descriptors: *Economics, California, Water demand, Water supply, Water quality, Decision making, Legal aspects, Contracts, Input-output analysis, Market value, Water costs, Planning, Recreation, Pricing, Cost allocation, Water quality control

Identifiers: *Research needs, Water quantity, Primary benefits, Secondary benefits, Economic growth, Feather River project.

Section I discusses the appropriateness of reconsidering the research task in California and proposes a research strategy relating to physical and social sciences. Section II discusses water demand and supply and water quality and quantity.

To research future state and regional economy, input-output models must be refined, casual analysis of factors influencing growth impetuses is needed, and effect of water availability on regional growth must be determined. Effects of water charges on residential users, public recreation use, agriculture, and sensitive industries deserve study. Water supply studies should focus on: emerging technologies, groundwater, and water quality. Section III discusses estimation of primary and secondary benefits. Discussion focuses on: planning in of water demand; recreation and other benefits lacking good market indicators; and irreversibilities. Section IV discusses economics of contracts and law. It focuses on: unsettled court issues; pricing and cost allocation; economic effects of legal procedures; and completing the Feather River project. Section V discusses decision-making processes. Problems for analysis include: the relationship of the state to the federal government, the effects of city growth on water districts, and arrangements for accomplishing quality control. Gossen-Chicago) W69-08383

ECONOMIC AND RELATED PROBLEMS IN RESOURCES CONTEMPORARY WATER

MANAGEMENT, Resources for the Future, Inc., Washington, D. C. Allen V. Kneese. Natural Resources Journal, Vol 5, No 2, p 216-258,

Oct 1965. 23 p.

Descriptors: *Administration, Economics, Water allocation (Policy), Water demand, Water costs, Water transfer, Waste disposal, Water quality, Water transfer, Waste disposal, Water quality, Flood control, Navigation, Optimum development

plans, Risks, Cost-benefit analysis. Identifiers: *Research needs, Recreation benefit estimation. Public investment.

The water resource economist-planner faces enormous problems and a lack of researched answers. The rapid urbanization and industrialization of American society; the growth of population and enormous expansion of the economy; and the rapidity of scientific and technological advances have created problems of strong conflicts between uses. Planners must evaluate water services whose market purchase at best generates indirect indications of their value. Projects are called upon not only to meet present and future demands for water but also to stimulate economic growth. Economic research and research on institutional capacities for these complexities is required. After summarizing past contributions of economic theory, the paper defines problems of: water transfer; recreation benefit estimation; waste disposal in water; integrated management of water quality and quantity; use of case studies; evaluation of present and future costs and benefits from public investments; and a method of handling risk and uncertainty. (Gossen-Chicago) W69-08384

WINDFALL GAINS FROM TRANSFER OF WATER ALLOTMENTS WITHIN COLORADO-BIG THOMPSON PROJECT, THE Economic Research Service, Washington, D.C.; and Colorado State Univ., Fort Collins.

Raymond L. Anderson. Land Econ, Vol 43, No 3, p 265-273, Aug 1967. 9 p. 6 ref

Descriptors: *Legal aspects, *Taxes, Federal Government, Rights. *Colorado-Big Thompson project, Identifiers: *Windfall gain.

Windfall gains may result when individuals sell water rights that have been developed as a result of governmentally financed water projects. This paper studies the effect upon the use and transfer of the water resources in question if the laws were changed to enable recapture of the unearned increments by the Federal Government through taxation. The Colorado-Big Thompson project is used as a case study to show the basis of the argument for recapture of windfall gains; also, the efficiency gains from the transfer of rights to the available water supply is examined. In conclusion the author states that under the situation that exists within the Colorado-Big Thompson project transfers of water allotments should be allowed even though windfall gains may result. Some of the windfall gains will be recaptured by the government through capital gains tax; also, the community will benefit by the more economically efficient use of the resources. (Grossman-Rutgers) W69-08385

CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER.

Oregon State Univ., Corvallis. Dept. of Agricultural Economics; and Oregon State Univ., Corvallis. Water Resources Research Inst.

Emery N. Castle. Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, p 23-32, Sept. 1968. 10 p, 11 ref.

Descriptors: *Social aspects, *Project planning, Transfer, Water quality.

The paper has four objectives: (1) state in dominant social issues influencing the group management of water in the United States; (2) describe some social problems related to water that are regional in nature; (3) develop some definitions and methodological constructions that are helpful in considering the administration of regional research on water; and (4) discuss the prospects for successful conduct of regional research on the economics of water. Water research stems from specific social problems. More than one discipline is needed to solve special problems. Such a multi-disciplinary approach adds to the complexity of regional research. (Grossman-Rutgers) W69-08386

REGIONAL ECONOMIC DEVELOPMENT AND

State Univ. of Iowa, Iowa City. Dept. of Economics.

Wilbur R. Maki.

Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, p 84-104, Sept 1968. 21 p, 2 fig, 5 tab, 17 ref.

Descriptors: *Water resources development, *Growth stages, Spatial distribution, *Regional

Identifiers: Infrastructure, Population density.

There are four policy issues relevant to water resource development: (1) identifying viable development planning regions; (2) establishing nodal points for stimulating regional growth; (3) achieving rural-urban balance; and (4) facilitating regional planning and community development. A region's water resources are related to its economic development. Economic areas of low population densities are contrasted with areas of high densities. Each area has its own particular problems. The four stages of regional growth are identified. Regions and subregions are delineated and export producing activities, spatial linkages, and regional organization are considered. A section on improving regional economic structures is included. It discusses industry mix and regional share and infrastructure and amenities. Also discussed is how to establish resource development priorities. (Grossman-Rutgers) W69-08387

WATER RESOURCE DEVELOPMENT: PUBLIC

WATER RESOURCE DEVELOPMENT: PUBLIC AND PRIVATE INVESTMENT,
Michigan State Univ., East Lansing. Dept of Agricultural Economics; and Michigan State Univ.,
East Lansing, Dept. of Resources Development. Allan A. Schmid.

Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, p 61-78, Sept 1968. 18 p, 29 ref.

Descriptors: *Investment, Economic efficiency, Interest rate, Return (Monetary). Identifiers: *Nonmarginal economic analysis.

The article discusses some problems of nonmarginal economic analysis; thus, the focus is on investments which fundamentally change the kind of inputs available and involve major changes in output choice. Also discussed are the choice of interest rate, the surplus crop question, and choice of investment criteria. Furthermore, investment involving public funds is linked with other institutional controls affecting resource use. The distributive issue of efficiency versus other values is examined. The uniqueness of water and public investment is also examined. In conclusion, the author states that the real problem is determining the proper mix of investments and how the returns of one investment affects the returns of the other. (Grossman-Rutgers) W69-08388

REGIONAL RESEARCH IN WATER IN THE

NORTH CENTRAL REGION, South Dakota State Univ., Brookings. Dept. of Economics; and Economic Research Service, Brookings, S. Dak. Gordon D. Rose, and Dean T. Massey.

Agricultural Law Center, College of Law, The University of Iowa, Monograph No 1, p 1-19, Sept 1968. 19 p, 2 append, 32 ref.

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Descriptors: *Water law, *Economic justification, *Project planning, Water resources development. Identifiers: *North Central Region, *North Central Research Project NC-57.

The focus of the monograph is on legal-economic regional research concerned with investigating problems regarding the use, allocation, and development of water resources. This article re-examines legal and economic regional water resources research in the North Central Region. First, the organizational structure for regional research is examined. Second, the history and accomplishments of the North Central Region Research Project NC-57 are discussed. Finally, present research efforts are evaluated, and suggestions for future research are made. The summary states that current activities could be conducted equally well without a regional project. Therefore, modification of the present method of conducting regional research is needed. Two selected bibliographies are included. (Grossman-Rutgers) W69-08391

Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences

John E. Reynolds, and Gary C. Jones.

Report-Institute of Food and Agricultural Sciences, The University of Florida, Pub No 3, Dec 1967. 116 p.

Descriptors: *Resource development, Project planning, Water pollution, Recreation, Optimum development plans. Identifiers: *Southeast U.S

This report contains the papers presented at a workshop on water research needs. The objectives of the workshop were: (1) to delineate economic research needs on problems of water resource development; (2) to identify and appraise alternative analytical procedures with respect to their usefulness in analyzing water resource problems; and (3) to stimulate and guide economic research on water resource problems. The following topics of significance are covered: The importance of research and planning in water resource develop-ment, the current federal program for river basin planning and the need for economic analysis, economics in water research, water-oriented outdoor recreation, economics of water pollution, optimization methods in water resources planning, and water resource economics research in the Southeast. (Grossman-Rutgers) W69-08392

OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES PROBLEMS,

Iowa Univ.; Iowa City. Coll. of Law. Dean T. Massey, and Gordon D. Rose Overall entry. Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, Sept 1968. 142 p, 1 append.

Descriptors: *Organizations, *Project planning, Water demand, Water supply, Water quality control, Data storage and retrieval. Identifiers: *North Central Region.

This monograph is a report of a seminar on water resources. The seminar had the following purposes: (1) To assess viable opportunities for regional research on water resources in the North Central States; (2) to furnish a basis for improvement of regional water research; and (3) to lay a foundation for a long term program of regional research on water. Specifically, the report covers regional research in water in the North Central Region, conceptual issues in the conduct of regional research on the economics of water, regional and national planning of agricultural research, water allocation, water resource development, regional economic development and water and data systems and infor-mation retrieval adaptable to water resources. A short discussion paper follows each article. (Grossman-Rutgers) W69-08393

AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIVER, Mississippi State Univ., State College. Dept. of Wil-

dlife Management. For primary bibliographic entry see Field 06G. W69-08399

A PROPOSED PARTNERSHIP COMPACT FOR **OUR NATION'S RIVER,**

Alvin C. Watson. Journal of Soil and Water Conservation, Vol 24, No 3, p 89-94, May-June 1969. 6 p, 5 ref.

Descriptors: *River basin development, *Interstate compacts, *Interstate commissions, *Water resources development, Water conservation, Flood protection, Water pollution control, Water utilizations Control and tion, State governments, Project purposes, Planning, Long range planning, Projects, Administrative agencies, Water management (Applied), Administration, Basins, Federal government, Pro-

grams. Identifiers: *Potomac River Basin.

Several of the reasons for attempting to set up an interstate-federal compact agency for the Potomac are: (1) the multiplicity of jurisdictions involved in water problems with a splintering of responsibilities, both compounded by a lack of coordination; (2) the studies that have set forth action programs which were never instigated; and (3) the need for comprehensive planning for water resources management. Problems of water supply, flood control and pollution have been focused on because of the Potomac's proximity to Washington. Recommendations from the President and the Corps of Engineers led a meeting of governors to appoint an advisory committee to set up the framework for a basin wide agency. That committee's proposal for a state-federal compact is outlined in detail. The most important role of the commission is to mobilize existing water resource agencies to perform their maximum responsibilities. The proposed interstate-federal compact would provide a mechanism for continuous planning and management of the basin's water resources. (Douberly-W69-08487

A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, Delaware Univ., Newark. Urban Affairs Div For primary bibliographic entry see Field 05D W69-08542

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS,

Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.

Leo R. Beard. Proc, Nat Symp Anal Water Resource Syst, p 278-288, Denver, July 1968. 11 p, 2 tab, 4 fig.

Descriptors: *Economics, *Computer programs, *Systems analysis, *Hydrologic properties, *Optimization, *Water resources, Reservoirs, Planning, Design, Evaluation.

Procedures of a comprehensive computer program that performed an elaborate hydrologic analysis of a system of reservoirs and assigned economic values to the output were described. The objective of the study was to lay a foundation for obtaining objective functions that expressed the socio-economic effects of a system, to provide inter-mediate hydrologic and economic data and a method of basing the actual design and operation of a hydrologic system on theoretical optimization techniques. The computer program described per-formed an elaborate and detailed sequential analysis of almost any configuration of water resource projects. System characteristics and requirements could be specified in any desired degree or detail with minimum effort. Output included detailed data on the month to month operation, as well as hydrologic and economic summaries useful for

rapid evaluation of system performance. (Thiuri-Cornell) W69-08543

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER-FRONT INPROVEMENTS. For primary bibliographic entry see Field 06E. W69-08180

DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, Kaiser Engineers, Oakland, Calif. For primary bibliographic entry see Field 03A. W69-08295

WATER RESOURCE DEVELOPMENT: PUBLIC AND PRIVATE INVESTMENT,
Michigan State Univ., East Lansing. Dept of Agricultural Economics; and Michigan State Univ., East Lansing. Dept. of Resources Development.
For primary bibliographic entry see Field 06B.

OPTIMAL TAXING FOR THE ABATEMENT OF

WATER POLLUTION, Carnegie-Mellon Univ., Pittsburgh, Pa. For primary bibliographic entry see Field 05F. W69-08547

THE ECONOMICS OF CLEAN WATER, Scott Paper Co., Philadelphia, Pa. For primary bibliographic entry see Field 05F. W69-08548

THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A PLANT SITE, Lockwood Greene Engineers, Inc., Spartanburg, S.

For primary bibliographic entry see Field 05G. W69-08553

6D. Water Demand

SUPPLY WATER METROPOLITAN WASHINGTON RI REPORT NO 1, REQUIREMENTS REGION. SOURCES. Metropolitan Washington Council of Govern-

ments. D. C.

Richard Hazen, Thomas M. Niles, Roy H. Ritter, and Abel Wolman.

Available from the Clearinghouse as PB 177 508 for \$3.00 paper copies and 65 cents in microfiche. Metrop Wash Counc Governments, Board of Eng Rep No 1, May 1967. 70 p, 7 fig, 14 tab.

Descriptors: *Water demand, *Water supply, *Water sources, *District of Columbia, *Urbanization, Municipal water, Industrial water, Planning, Forecasting, Dams, Reservoirs, Streamflow, River basin development.
Identifiers: Washington DC Metropolitan area,
Potomac River.

The Washington Metropolitan Region is considered to encompass an area of 3,000 sq mi, including the District of Columbia and adjacent cities cluding the District of Columbia and adjacent cities and counties on both sides of the Potomac River. The population of the region is expected to increase from 2.6 million at present to 4.2 million by 1985 and 6.1 million by 2010. Average dry year water demands will grow from 320 mgd supplied by major systems in 1966 to 670 mgd in 1985 and to 1050 mgd by 2010. Of the total 110 to 150 mgd probably will be drawn from local sources other them. probably will be drawn from local sources other than the Potomac River. Peak daily demands in drought years will exceed average requirements by approximately 80 per cent. The water needed from

Water Law and Institutions—Group 6E

the Potomac River or other non-local sources will average 560 mgd and 900 mgd in 2010. Maximum month requirements will be 728 mgd in 1985 and 1170 mgd in 2010. Maximum day demands will be 995 mgd in 1985 and 1620 mgd in 2010. The unregulated Potomac River cannot be depended upon for more than 374 mgd which barely supplied the water used in 1966, when some water restrictions were enforced. Increasing water demands and recurring major drought conditions will require severe curtailment of water use unless additional dependable supply is provided as quickly as possible. (Knapp-USGS) W69-08257

WATER ALLOCATION: SUPPLY AND DE-MAND RELATIONSHIPS, State Univ. of Iowa, Iowa City. Dept. of

Economics.

John F. Timmons.

Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, p 44-56, Sept 1968, 13 p, 1 tab, 15 ref.

Descriptors: *Demand, *Water quality, *Water supply, Pricing, Water values.

In regard to water resource research the author reconsiders the following concepts: (1) mythology of uniqueness and shortages imputed to water, (2) sanctity of present allocative devices, (3) allocation and/or development, and (4) homogeneous illusions of water supplies and demands. Approximations of demands for and supplies of water are differentiated into three groups: (1) qualities linked with demands by amounts and qualities linked with supplies by amounts, (2) spatial occurrences of quality linked supplies and of quality linked demands, and (3) temporal occurrences of quality linked supplies and quality linked demands. Two fundamental characteristics of the supply of and demand for water insofar as quality is concerned are: (1) quality heterogeneity of water supplies, and (2) quality differentiation demand according to uses. Allocation alternatives for prospective supplies and demands are examined. Also discussed is the identification of supply-demand water use entities, and the development of water use firms identified by water use entities. (Grossman-Rutgers) W69-08390

WATER USE AND RELATED COSTS WITH COOLING TOWERS,

Illinois State Water Survey, Urbana, Ill. For primary bibliographic entry see Field 05G. W69-08407

6E. Water Law and Institutions

WATER POLLUTION CONTROL. For primary bibliographic entry see Field 05G. W69-08127

RIVER AND HARBOR IMPROVEMENT.

33 USCA secs 591, 594, 601 (1957).

Descriptors: *Condemnation, *Compensation, *Condemnation value, *Mississippi River, Rivers and Harbors Act, Federal grovernment, Federal project policy, Administrative agencies, United States, Water resources development, Legislation, Legal aspects, Easements, Reservoirs, Right-of-way, Regulation, Appropriation, Administrative decisions, Land tenure, Public benefits. Identifiers: Secretary of the Army, Penalties (Criminal), Improvements.

The Secretary of the Army may institute proper legal proceedings for the acquisition by condemna-tion of any land, right-of-way or material needed to maintain or prosecute works for the improvement of rivers and harbors. When the owner of such land, right-of-way or material fixes a price for the

same, which is reasonable to the secretary, he may purchase the same at that price. The secretary may accept donations of lands or materials. Whenever secretary institutes such condemnation proceedings, the United States shall have the right to take immediate possession of lands, easements or rights-of-way, provided that just compensation shall have been made to those people entitled thereto. The secretary shall prescribe such rules and regulations regarding the use and administration of reservoirs at the headwaters of the Mississippi River as he judges the public interest and necessity require. Such rules shall be made public information. Any person knowingly violating such rules shall be subject to a fine or imprisonment. Carruthers-Fla) W69-08128

WATER CONSERVATION AND IRRIGATION CORPORATION.

Ala Code tit 12 secs 280-297 (1959).

Descriptors: *Alabama, *Water conservation, *Irrigation, Irrigation programs, Irrigation practices, Local governments, Legislation, Wells, Water supply, Flood control, Multiple-purpose projects, Municipal water, Industrial water, Eminent domain, Financial analysis, Cost allocation, Costs, Construction, Projects, Permits, Public benefits, Impoundments, Administrative agencies, Construction costs.

Identifiers: Water conservation and irrigation cor-

The governing body of any county can declare the need for a water conservation and irrigation corporation. The contents and requisites of the certificate of incorporation, mode of its filing, and details regarding the board of directors and officers of the corporation are set forth. Such corporation shall have the power to: (1) provide a water supply by stream impoundment or wells, (2) develop and operate an irrigation project, (3) provide for flood control, (4) provide for multiple purpose developments, (5) enter into agreements and contracts with agencies of the federal government. Detailed procedures are outlined for the obtaining of permits for construction projects. The duties of the director of the department of conservation are included. Bonding and other financing matters necessary for the operation of such corporations are set forth. All counties, cities, towns and other political subdivisions are authorized to lease or convey real property to the corporation. Construction awards will be based on sealed bids and publicly advertized. Authorized agents and employees of the corporation shall have a right of entry on land, water and other premises to make surveys, drillings and examinations. Such corporations shall be exempt from all taxation in the state of Alabama. (Carruthers-Fla) W69-08129

FLOOD CONTROL AND SOIL CONSERVA-

For primary bibliographic entry see Field 04A W69-08130

KEEP MAINE SCENIC; ALLAGASH RIVER AUTHORITY.

Me Rev Stat Ann tit 12, secs 631-633, 661-680 (Supp 1968-69).

Descriptors: *Maine, *Habitat improvement, *Shelterbelts, *Maine, *Habitat improvement, *Shelterbelts, *Wildlife management, Watershed management, River basin commissions, Soil conservation, Wildlife conservation, Legislation, Scenery, Aesthetics, Conservation, Recreation, Scenic easements.

Identifiers: Wilderness areas.

The Maine State Park and Recreation Commission is to maintain a continuing keep Maine Scenic Program. A 12 member advisory committee to advise and consult with the State Park and Recreation Commission to carry out a general program for the elimination of litter along Maine's roadsides, beaches, and waterways is provided for. The Allagash River Authority and Wilderness Waterway is created to preserve and develop the state's waterways and wilderness recreational areas, and to prevent erosion, droughts, freshets and the filling up of waters. The Authority has the power to acquire land, water and power rights by purchase, rental or eminent domain. The Authority may also establish rules and regulations for the effective governance of the waterway and impose fines and imprisonment for their violation. The Act provides for a restricted zone of from 400-800 feet of the waterway to protect and develop its maximum wilderness character. The use of power driven watercraft along the waterway is forbidden and the building or expansion of structures within the restricted zone, except with Authority approval, is to be prevented. Existing sporting camps are to be bought by the Authority and leased back to the owners on terms and conditions imposed by the Authority. (Blunt-Fla) W69-08131

WESTERN AND ATLANTIC RAILROAD V HASSLER (DAMAGES CAUSED BY IN-CAUSED BY IN-ADEQUATE CULVERT).

92 Ga App 278, 88 SE 2d 559-565 (1955).

Descriptors: *Georgia, *Flood Damage, *Precipitation excess, *Rainfall intensity, Judicial decisions, Damages, Rainfall, Precipitation, Rail-roads, Culverts, Rainfall Disposition, Excessive precipitation, Runoff, Drainage, Surface runoff, Floods, Cloudbursts, Streams, Nonnavigable waters, Mills, Riparian land, Culverts, Drainage, Natural flow.

Identifiers: Act of God, Negligence.

Plaintiff owned a mill adjacent to a non-navigable creek. The creek flowed through a culvert under defendant's tracks approximately two thousand feet from the mill. The culvert was adequate in area to take care of the normal flow of the creek. The defendant raised its tracks two and one-half feet, and reinforced the culvert by adding several inches of new masonry, thereby reducing the flow of water through the culvert by about fifteen percent. The raising of the tracks prevented the overflow of the water in time of heavy rains. During such rains, plaintiff's mill and cotton gin were damaged because of flooding. The question presented was whether damage resulted from an act of God or through the fault of the railroad. The court held that this was a question for the jury. If the flood that did occur was so extraordinary and unprecedented that it could not have been foreseen and the damage could not have been prevented by pru-dential means, the railroad could not be held liable. (Heckerling-Fla) W69-08132

THOMAS V LACOTTS (REASONABLE USE OF RIPARIAN WATERS).

257 SW 2d 936-941 (Ark 1953).

Descriptors: *Arkansas, *Riparian rights, *Alteration of flow, *Reasonable use, Pumping, Natural use, Legal aspects, Judicial decisions, Obstruction to flow, Pumps, Underground streams, Farms, Hunting, Suppose, Streams, Paris, Hunting, Surveys, Streams, Bayous, Water shortage, Damages, Dams, Land tenure, Riparian land, Boundaries (Property). Identifiers: Evidence

Plaintiff's property is separated from defendant's land by a meandering stream. Defendant dammed the stream at a point immediately before it entered the plaintiff's property. Plaintiff contended that the dam interferred with his riparian rights and lowered the underground water level causing plaintiff additional expenses in pumping. The court held that a riparian owner is entitled to the unimpaired natural

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

flow of a stream over his land, but this right is subject to reasonable uses by upper proprietors. Under the riparian doctrine, no proprietor has priority in the use of water in derogation or another's rights. The damages assessed by the Chancellor were affirmed. (Shevin-Fla) W69-08133

UNITED STATES V STATE OF LOUISIANA (LOUISIANA BOUNDARY CASE).

89 S Ct 773-817, (1969).

Descriptors: *Federal-state water rights conflicts, Descriptors: *Federal-state water rights conflicts, *State governments, *Boundary disputes, *Boun-daries (Surfaces), Legal aspects, Jurisdiction, Earth-water interfaces, Interfaces, Water law, Boundary processes, Political aspects, Federal government, Federal jurisdiction, Judicial deci-sions, Legislation, State jurisdiction, Water rights.

Plaintiff asks for a declaration that it is entitled to exclusive possession of and power over lands under the Gulf of Mexico which are more than three geographical miles from the coast. A previous case construing the Submerged Lands Act of 1953 held that the United States was entitled to submerged lands seaward of the three mile limit. Both parties ask for a supplementary decree designating actual boundaries. Such determination requires interpretation of the phrase 'the line marking the seaward limit of inland waters' from the prior case. That line must be drawn in accordance with the definitions of the Convention on the Territorial Sea and the Contiguous Zone. Consideration in construing such definitions is given to islands and their relationships to the mainland, their size, distance from mainland, depth and utility of intervening waters, shape of island, and relationship to configuration or curvature of the coast. The choice under the convention to use the straight base line method for determining inland waters against other nations rests with the federal government and not with the states. A special master was appointed to determine the actual boundaries by means consistent with this opinion. (Johnson-Fla) W69-08134

CITY OF NEW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES RIGHT TO NAVIGABLE STREAM). 105 NYS 2d 459-473 (SC 1951).

Descriptors: *New York, *Public utilities, *Ownership of beds, *Navigable waters, Streambeds, Gases, Bridge construction, Pipelines, Public Gases, Bridge Construction, Fipelines, Facility rights, Easements, Proprietary power, Grants, Prescriptive rights, Access routes, Roads, Relative rights, Projects, Safety, Riparian rights. Identifiers: *Obstruction to navigation, *Nuisance

(Public), Highway commissions.

The city brought suit to enjoin a gas company from maintaining a bridge and certain gas pipelines which were attached to the bridge and laid in the bed of a navigable stream. Defendant asserted that plaintiff, as successor in interest to the town, did not get absolute ownership of the creek bed since the town's highway commissioners had granted to defendant the right to do all things necessary to supply gas to the town. This impliedly gave defensupply gas to the town. This implication and adapt the right to use the creek bed as gas-pipe access route. Moreover, defendant alleged that the bridge was constructed pursuant to recommendations by a department of plaintiff-city. The court depared that this authorization was made on the declared that this authorization was made on the condition that the federal government consent because the creek was a navigable stream. Any bridge construction without such permission did not give defendant the right to continue to use the bridge. The court ruled that since defendant failed to show the highway commissioners' power to grant the right to use the creek bed, such right could not be created by implication, especially where an obstruction of a navigable waterway would be caused thereby. The court concluded that defendant must remove the pipes and bridges at its own expense

because defendant's right to exercise its franchise was subject to regulation when public safety required. (Reed-Fla) W69-08135

MINNESOTA-WISCONSIN BOUNDARY COM-PACT (PURPOSE AND INTENT).

Minn Stat Ann sec 1.31 (1967), as amended, (Supp

Descriptors: *Minnesota, *Interstate compacts, *Interstate commissions, Federal government, Legislation, Soil conservation, Soil erosion, Agriculture, Dams, Navigation, Water pollution, Recreation, Fish, Wildlife conservation, Water resources development, Water policy, Planning.

Minnesota agrees: to cooperate with other states party to this compact in establishing a boundary area commission; to consider the commission's recommendations with respect to regional planning for boundary areas and; to consider measures for controlling air and water pollution, programs for erosion control; diversion of waters from and into the rivers, and restrictions of land use to preserve recreation in river basins. The commission shall consist of five commissioners from each state with the powers and duties to make recommendations and correlate studies of the federal government and other agencies. No recommendation, plan or finding of the commission shall have the force of law or be binding upon any state agency. Studies may be made for determining the most beneficial plans for: regional development, navigation, dams, agriculture, fish and wildlife, recreation, commerce, pollution, other beneficial purposes. The commission is to be financed by donations and state appropriafrom the compact at any time. (Kahle-Fla)

AIRCRAFT; UNDERGROUND GAS STORAGE. Minn Stat Ann secs 84.49 to 84.53 (1964), as amended, (Supp 1964).

Descriptors: *Minnesota, *Aircraft, *Boats, *Zoning, Administrative agencies, Legislation, Boating, Transportation, Airports, Regulation, Permits, Legal aspects. Identifiers: Penalties (Criminal).

No aircraft pilot, owner or operator shall keep any watercraft at certain designated wilderness areas except at private property with a residence thereon. Any watercraft kept or maintained in such a way so as to violate these provisions shall be subject to confiscation, as contraband, and any violation shall be a misdemeanor. (Helwig-Fla) W69-08137

UNDERGROUND GAS STORAGE.

Minn Stat Ann sec 84.57 (1964), as amended, (Supp 1968).

Descriptors: *Gases, *Underground storage, *Permits, *Subsurface waters, Administrative agencies, Legal aspects, Underground streams, Pressure, Legislation, State governments, Local governments, Cities, Relative rights. Identifiers: Penalties (Criminal).

It shall be unlawful for the state or any person or any political subdivision to displace any underground waters by the underground storage of gas or liquid under pressure without a permit from the Commissioner of Conservation. (Helwig-Fla)

REFORESTATION, AFFORESTATION AND FLOOD CONTROL PROJECTS.

Minn Stat Ann secs 84A.21, 84A.22, 84A.27 to 84A.30 (1947).

Descriptors: *Minnesota, *Forests, *Flood control, *Forest management, Forest fires, Forestry, Land use, Eminent domain, Administrative agencies, Conservation, Supervisory control (Powers), Reforestation, Wildlife, Lakes, Streams, Local governments, Land, Legislation, Projects, Management, Wildlife conservation, Recreation, Regulation, Water management (Applied), Permits, Hunting, Natural resources, Appropriation, Legal aspects. Identifiers: Afforestation, Penalties (Civil).

Certain reforestation and flood control projects shall be under the control and management of the Department of Conservation. The Department is authorized to make rules for: the care of forests; reforestation and afforestation; regulation of the waters of meandering lakes and flowing streams; prevention of forest fires; and the sale of timber. In addition, the department is empowered to regulate wildlife and recreational activities. All land, private and public, within the projects shall be subject to these rules. All money received in connection with any project shall be credited to said project in the state treasury and shall be appropriated for the purposes thereof. Lands certified to be suitable for reforestation or water control shall be acquired by the state for such purposes. The Department is authorized to accept gifts of land or personalty in any project which it deems suitable for such purposes. The Department has the authority to acquire land by the right of eminent domain for any such project. Violators of any rule pertaining to any project shall be guilty of a misdemeanor. (Helwig-Fla) W69-08139

CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDEMNATION VALUE OF ACCRETED LAND).

130 NE 2d 421-430 (Ohio Ct App 1955).

Descriptors: *Ohio, *Condemnation, *Riparian land, *Lake Erie, Navigable waters, Lake shores, Indicated decisions Processing Processing Processing Processing Processing Processing Processing Processing Processing Process Judicial decisions, Boundaries (Property), Landfills, Land tenure, Condemnation value, Damages, Competing uses, Accretion (Legal aspects), Boundaries (Property), Legal aspects, Water law. Identifiers: *Littoral proprietorship, *Public trust doctrine.

In a lower court lessee recovered a \$50,000 judgement for damages against the city of Cleveland, the condemnor. The basis of the suit was interference by the city with leased realty along the shoreline of Lake Erie by constructing a freeway on part of plaintiff-lessee's leasehold adjacent to the Lake Erie shoreline. On appeal by the condemnor on questions of law, the Ohio Court of Appeals reversed and remanded. In the lower court, condemnor was not allowed to introduce evidence that the lease purported to cover land formed by filling in the waters of Lake Erie beyond the natural shoreline. The upper court held that this evidentiary exclusion constituted prejudicial error since, if condemnor's allegation were true, the title to the shoreline over which this dispute arose would repose in the state of Ohio as trustee for the people and any lease executed pertaining to such land would be void ab initio. The littoral rights of plaintiff under such circumstances would be subject to regulation and control by the state and federal governments. (Carruthers-Fla) W69-08140

GAME AND FISH.

Minn Stat, Ann secs 97.40 to 97.57 (1957).

Descriptors: *Minnesota, *Wildlife, *Conserva-tion, *Fishing, Hunting, Animals, Legislation, Fish, Wildlife management, Administrative agencies, Natural resources, Permits, Regulation, Public lands, State governments, Legal aspects, Land management, Mussels, Eminent domain, Fish conservation, Wildlife conservation, Land resources, Water law.

Water Law and Institutions—Group 6E

The state shall have ownership, control and the responsibility of wild animals, fish and aquatic vegetation in the state. The Commissioner of Conservation shall have the authority to regulate the taking, possession, transportation, storage and disposition of protected game and fish within the state. The commissioner shall have broad powers over wildlife conservation, fishing, control of rough fish, interstate conservation agreements, mussels and animal propogation. The commissioner may acquire land for conservation, public hunting and recreational purposes. The commissioner may designate experimental waters and regulate activity. He shall serve warrants and make arrests for offenses relating to conservation. He shall have powers to search for, confiscate and dispose of il-legally taken wildlife. Penalties shall be authorized and imposed for violations of this law. (Helwig-Fla)

POSSESSION AND TRANSPORTATION OF PROTECTED GAME AND FISH. Minn Stat Ann secs 97.40 to 97.47 (1957).

Descriptors: *Minnesota, *Wildlife, *Conservation, *Wildlife management, Animals, Fish, Furbearers, Beavers, Muskrats, Hunting, Fishing, Mammals, Legislation, Administrative agencies, Natural resources, Wildlife conservation, Permits,

Legal aspects, Regulation, Fish management. Identifiers: Protected animals, Tanners.

The ownership of wild animals and aquatic vegeta-tion in public waters is in the state. No one shall take or possess any wild animals except as permitted by law and during open season. No one shall keep protected wild animals in commercial cold storage. Protected wild animals may be disposed of by gift subject to restriction. Mounted animals and furs are excepted from this section. Tanners shall tag all beaver and muskrat hides in their possession. Any person may transport in open season, within or without the state, any protected animal which may be lawfully sold. Fish lawfully taken, may be carried by a resident or transported by common carrier, consigned to himself. A licensed non-resident may transport a restricted amount of dressed or undressed fish within or without the state or may carry his legal limit lawfully taken anywhere. All containers of fish shall be clearly marked for identification. Minnows shall not be transported outside the state. Confiscation of any part of a shipment as contraband shall extend to the entire shipment. No person shall waste any usable part of protected wild animals. (Helwig-Fla) W69-08142

POWERS AND DUTIES OF THE COMMISSIONER OF CONSERVATION.

Minn Stat Ann secs 97.48, 97.481 (1957).

Descriptors: *Minnesota, *Administrative agencies, *Conservation, Fishing, Hunting, Wildlife management, Hatcheries, Recreation, Interstate compacts, Regulation, Wetlands, Marshes, Legislation, Legal aspects, Wild rice, Deer, Fish conservation, Water conservation, Experimental farms, Land management, Land resources.

The Commissioner of Conservation is empowered to: reduce seasons or limits on wildlife to reduce depletion and promote propagation; enter contracts with certain other states to remove rough fish from boundary waters; regulate fishing and hunting in boundary and international waters; take and dispose of rough fish from state waters; close areas to the taking of mussels or minnows; preserve desirable wildlife; destroy undesirable wildlife; carry on a wildlife breeding and stocking program; acquire property for game farms, hatcheries, hunting grounds, game preserves and recreational areas; protect fish in shallow or receding waters; regulate wild rice production; promote conservation among civic groups; issue permits for taking turtles or frogs by light; regulate hunting seasons; regulate deer hunting in small hunting refuges to

promote safety; pose certain land under his jurisdiction as wildlife management areas; designate certain lakes as experimental waters and regulate activity thereon; and acquire and develop wetlands in the interests of water conservation to the end of wildlife conservation or recreation. (Helwig-Fla) W69-08143

POLICE POWER AND DUTIES OF THE COM-MISSIONER OF CONSERVATION. Minn Stat Ann secs 97.50, 97.501, 97.55 to 97.57

Descriptors: *Minnesota, *Conservation, *Regulation, *Wildlife, Water law, Wildlife conservation, Permits, Dams, State governments, Administrative agencies, Water pollution, Drainage, Jurisdiction, Legal aspects, Legislation, Beavers, Fishing, Hunt-

Identifiers: *Police power, Penal statutes.

The Department of Conservation shall not stock any waters to which the public is denied free access. The Commissioner of Conservation shall grant to anyone taking rough fish under permit the right to sell such fish to any person. The commissioner may sell rough fish taken by fishermen under contract with the state. Moneys received from licenses, fines, sale of contraband, and reimbursements to the department shall be credited to a game and fish fund to be used for related purposes. The commissioner and his agents are empowered to serve all warrants for violations relating to wild animals, use and protection of water, conservation, dams and water pollution. They may arrest persons violating conservation laws. They may search and inspect certain premises and items for contraband and may confiscate game illegally taken and items used in the taking. The commissioner may enter into reciprocal agreements with the United States and other states for interjurisdictional appointment of game wardens. The department may remove any beaver dam interfering with proper drainage. (Helwig-Fla) W69-08144

MINERAL LANDS AND LEASES.

Minn Stat Ann secs 93.01, 93.05 to 93.13, 93.34 to

Descriptors: *Minnesota, *Mining, *Mineral industry, *Permits, Leases, Mining engineering, State governments, Mineralogy, Navigable waters, Lakes, Beds, Exploration, Exploitation, Drainage, Condemnation, Easements, Right-of-way, Owner-ship of beds, Streambeds, Water law, Riparian rights, Legislation, Legal aspects, Hydroelectric power, Contracts, Royalties.

The state reserves for its own use all valuable minerals and all water powers in land belonging to it. The holder of any mineral permit or lease in land may enter thereon and prospect. Before entry on the land any permit holder shall pay the land owner security for any damages. Upon request of any permit holder, the attorney general may initiate proceedings to condemn land in connection with any prospecting. All minerals under navigable lakes belong to the state. The Department of Conservation shall adopt regulations for the issuance of permits to mine beneath public waters. The holder of a mineral lease shall have the right to mine within the area covered by the lease. Anyone failing to comply with the terms of a lease shall forfeit such lease. Certain lakes may be drained and the iron ore removed from the bed. No one shall mine or drain a public lake without authority. The Commissioner of Conservation may sell mining permits for the beds of public waters. The holder of a permit may obtain a mineral lease and pay a royalty thereon to the state. (Helwig-Fla)

BOARD OF COUNTY COMMISSIONERS V PATE (FORFEITURE OF ILLEGAL FISHING **DEVICES).** 221 So 2d 732-734 (Fla 1969).

Descriptors: *Florida, *Fish conservation, *Fishing devices, Fishing, Boats, Legislation, Legal aspects, Judicial decisions, Sport fish, Recreation, Water sports, Conservation, Boating, Sport fishing, Regulation, Fish. Identifiers: *Forfeiture, Penalties (Civil).

The Florida Supreme Court quashed consolidated cases of the Florida Second District Court of Appeal which construed the phrase 'net, traps or fishing devices' in Fla Stat sec 372.31 as excluding boats and motors used directly and on the water in poaching operations. The court held that the district court decisions were in direct conflict with the Florida Supreme Court case of Bruce v Malloy, 150 Fla 157, 7 So 2d 123 (1942) which construed an earlier version of Fla stat sec 372.31 as allowing forfeiture and disposal of boats and motors, and ac cordingly quashed and remanded the consolidated decisions of the district court. Justice Boyd dissented a length contending that Bruce v Malloy did not rule on the question of whether boats and motors were included in the forfeiture provisions of the statute and that the legislative history regarding revisions of the statute revealed an intent to exclude boats and motors from its coverage. (Carruthers-Fla) W69-08146

PATUXENT RIVER WATERSHED.

MD Ann Code art 66C secs 411A thru 411U (1957).

Descriptors: *Maryland, *Watersheds (Basins), *Flood protection, *Watershed management, Conservation, Local governments, Legislation, Planning, Regulation, Land management, Costs, Taxes, Public benefits, Docks, Recreation, Roads, Beaches, Forests, Forest management, Parks, Erosion, Leases.
Identifiers: *Patuxent River, Misdemeanors, State

agencies.

Counties in which a portion of the Patuxent River watershed is located, in cooperation with each other and the Department of Forests and Parks, are authorized to acquire land and adopt a watershed plan for the purpose of instituting a program of conservation and flood prevention. The plan shall include the proposed location and uses for such lands. After public hearing, the plan may be adopted by a majority vote of the county commissioners. The commissioners may make regulations for the use of the land, violations of which are deemed misdemeanors. The lands may be leased by the counties to private persons for periods not exceeding 20 years and for uses not inconsistent with the plan. Funds for acquisition of land may be obtained by donation, appropriation by the state or federal government, or by special taxes imposed by the county in conjunction with 50% matching funds from the Department of Forests and Parks. (Kahle-W69-08147

PATUXENT RIVER WATERSHED.

MD Ann Code Art 66C secs 411A through 411 K (1957).

Descriptors: *Maryland, *Watershed management, *Local governments, Flood protection, Erosion, Legislation, Planning, Watersheds (Basins), Lland management, Public benefits, Docks, Roads, Beaches, Recreation, Cost, Leases, Conservation. Identifiers: Patuxent River.

Howard, Montgomery, Prince George's, Anne Arundel, Calvert, Charles and St. Mary's counties, acting jointly and with the Department of Forests and Parks are authorized to define the Patuxent

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

River watershed in their counties for the purpose of protecting the watershed by a program of flood prevention and conservation. Each county may adopt and amend a watershed plan of recommendations for the protection of the watershed. Such plan shall include the location and proposed uses of lands to be acquired and the locations of roads, waterways, waterfronts, beaches, docks, parks, forest preserves, wildlife refuges and recreational areas. Before adopting or amending the plan the county must hold a public hearing, after 30 days notice, with the majority of the county commissioners voting in favor of the resolution. Each county may acquire and develop land (either within or without the county) necessary to carry out the plan. Land acquisition may be financed by donations or appropriations from the United States, the state of Maryland, or private persons. The counties may lease such lands or grant concessions to individuals for periods not exceeding 20 years and for purposes not inconsistent with the watershed plan. (Kahle-Fla) W69-08148

PATUXENT RIVER WATERSHED.

MD Ann Code Art 66C secs 411 L through 411 U (1957).

Descriptors: *Maryland, *Watershed management, *Flood protection, *Land management, Erosion, Conservation, Planning, Regulation, Legislation, Watersheds (Basins), Taxes, Costs, Forest management, Parks, Forests, Local governments, Administrative agencies, Regulation.
Identifiers: *State agencies, Misdemeanors.

The county commissioners may make rules and regulations for the use of land acquired under this subtitle. These rules and regulations shall be posted on the lands and published in local newspapers. Violations of the regulations are deemed misdemeanors punishable by fine and/or imprison-ment. The Department of Forest and Parks shall include requests for funds to be used for acquisition of lands in its annual budget. Such funds are to be matched by the county acquiring the land. The Department shall cooperate with the counties in formulating a Patuxent River watershed plan, and in acquiring land. The counties are authorized to levy an annual special tax upon all property in the county, the proceeds of which shall be used for the acquisition of land under the watershed plan. (Ka-W69-08149

WATERSHED PROTECTION AND FLOOD PREVENTION.

For primary bibliographic entry see Field 04A. W69-08150

NEW ENGLAND INTERSTATE WATER POL-LUTION CONTROL COMPACT. For primary bibliographic entry see Field 05G.

W69-08151

DRAINAGE DISTRICTS UNDER 1911 ACT. For primary bibliographic entry see Field 04A. W69-08152

ACQUISITION OF A CERTAIN DAM AND WATER RIGHTS.

NH Rev Stat Ann secs 482-A:1 thru 482-B:3 (1968).

Descriptors: *New Hampshire, *Administrative agencies, *Dams, Taxes, Repairing, Rehabilitation, Water control, Public benefits, Water resources development, Dam construction, Water rights, Legislation.

Identifiers: *Acquisition, Mirror Lake dam, Buck Street dam.

For the consideration of one dollar, the New Hampshire Water Resources Board is authorized to acquire from the owners thereof the Mirror Lake and Buck Street dams, the water rights, and lands used in connection with these dams. The acquisitions are made for the purpose of improving and controlling certain water rights for benefit of the state. The New Hampshire water resources board is authorized to make repairs and modifications after acquisition of the property. The properties are exempt from taxation while held by the state. (Gadd-Fla) W69-08153

SEWAGE DISPOSAL SYSTEMS NEAR SHORELINES.

For primary bibliographic entry see Field 05E. W69-08154

LOCAL PROVISIONS.

For primary bibliographic entry see Field 05G. W69-08155

WATER SKIS, SURFBOARDS AND AOUAPLANES; REGATTAS, ETC.

SC Code Ann secs 70-295.51 thru 70-295.56 (1962), as amended, (Supp 1968).

Descriptors: *Surfboarding, *Recreation, *South Carolina, *Waterskiing, Boats, Legislation, Regulation, Permits, Safety, Equipment, State jurisdiction, Federal jurisdiction. Identifiers: Regattas.

A motorboat towing a person on water skis or similar device must either have an observer in addition to the operator or be equipped with a rear view mirror. Water-skiing and surfboarding are prohibited between one hour after sunset and one surfboarding are hour before sunrise. Skis or surfboards shall not be operated so as to collide with any object or person. Persons, other than performers in tournaments, must wear life belts while on skis or surfboards. Regattas or exhibitions may be authorized upon application made 15 days in advance. The date, time and location of the event shall be set forth. Nothing herein shall be construed as creating an exemption from federal regulation, but no state permit need be acquired if a permit has been granted from a federal authority. (Kahle-Fla) W69-08156

WATERS AND WATERCOURSES: NORTH CAROLINA LINE TO WINYAH BAY.

SC Code Ann secs 70-281 thru 70-287 (1962).

Descriptors: *South Carolina, *Inland waterways, *Condemnation, *Right-of-way, Surveys, Eminent domain, Compensation, Damages, United States, Administrative agencies, Legislation, State jurisdiction, Federal jurisdiction, State governments, Land tenure, Land reclamation, Financing, Costs, Monetary benefits, Beds under water.

Identifiers: Compensation offset.

The state may grant land to the United States to aid construction of the inland waterway by the United States from the North Carolina-South Carolina border to Winyah Bay. The width of right-of-ways shall vary between 1000 and 1750 feet, depending upon the elevation above sea level. Lands previously submerged which are raised by excavation deposits shall become the property of the United States. Lands privately owned by any person or corporation or condemned by an political subdivision of the state may be acquired by the State Development Board and be deeded to the United States for purposes of this article. The Board may obtain a right-of-way by condemnation if unable to secure it otherwise. Benefits to the owner of such land shall be offset against any compensation awarded. The United States may condemn lands at state expense. In condemnation proceedings the uses under this act are paramount to all other public uses. To determine which lands are necessary under this article, the Board or the United States may enter and survey and no claim shall arise against them because of such entry. The state retains concurrent civil and criminal jurisdiction over the lands acquired under this article. (Harris-Fla) W69-08157

LANDOWNERS IN YORK COUNTY TO CLEAN OUT STREAMS.

SC Code Ann secs 70-201 thru 70-204 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Streamflow, *Obstruction to flow, *Land tenure, Legislation, Streams, Natural flow, Local governments, Relative rights, Cost repayment, Costs, Engineers estimates, Boundaries. Identifiers: *York County, Notice, Townships.

All landowners and their agents in York County shall, between July 5 and August 15, clear all obstructions and debris that obstruct the natural flow of running streams on their lands. The governing body of the county may extend the time for clearing due to illness or other necessity. The governing body shall give annual notice by mail between July 1 and July 10 to each owner or his agent of the requirement of this act. The township commissioners shall inspect all running streams in their townships between August 15 and August 20. They shall then notify the governing body of the county of all delinquents by August 25, and supply an estimate of the cost of cleaning the delinquent's stream. The county shall then clean the stream and pay for it from the county fund. The expense shall be a first lien on the delinquent's property, which may be sold and title made in the same manner as a real estate foreclosure. (Harris-Fla)

LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT STREAMS.

SC Code Ann secs 70-191 thru 70-196 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Streamflow, *Obstruction to flow, *Natural flow, Debris, Legislation, Local government, Regulation, Boundaries (Property), Control, Costs, Cost repayment, Land tenure, Relative rights, Natural streams, Financing. Identifiers: *Chester County, *Cherokee County, *Stream cleaning, Notice.

Between July 10 and July 15 of each year, Chester and Cherokee County landowners shall remove all obstructions to natural flow of running streams on or bounding their land. Upon just grounds the time may be extended by the governing body of the county. Published notice of the requirement shall be given in each county, and personal notice shall be given to each owner along a stream upon request of two or more such owners. After personal notice, if any landowner refuses or neglects to clean a stream, the county shall procure estimates and clean the stream upon advancement of necessary funds by persons interested in cleaning the stream. The cost shall be a first lien on the lands of the delinquent owner, and shall be filed as in the case of a mechanic's lien. If the delinquent landowner refuses or neglects to pay, the lien may be foreclosed as is a real estate mortgage. Costs recovered by foreclosure shall be paid to the party advancing funds or cleaning the stream. The article is supplementary to other laws for cleaning streams and does not repeal them. (Harris-Fla) W69-08159

SAVANNAH RIVER NAVIGATION COMMISSION.

SC Code Ann secs 70-51 thru 70-49 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Navigable rivers, *Administrative agencies. *Condemnation, Descriptors: *South Carolina, *Navigable rivers, *Administrative agencies, *Condemnation, Federal jurisdiction, State jurisdiction, United States, Channels, Navigable waters, Costs, Road construction, Bridges, Easements, Flow, Federalstate water rights conflicts, Legislation, Salaries, Construction, Navigation.

Identifiers: *Flowage rights, *Savannah River Navigation Commission, State Highway Department, Civil and criminal process.

The governor shall appoint 5 citizens as members of the Savannah River Navigation Commission to aid the United States in construction and maintenance of channels in the Savannah River below Augusta, Georgia. The members shall be appointed and serve terms, without compensation, as provided in this chapter. A majority may act at a duly called meeting. From the upper limits of Savannah Harbor, Georgia to the upper limits of Augusta, Georgia, the commission may represent local interests in dealing with the United States. The State Highway Department shall cooperate by changing highways, bridges, and approaches necessary for navigation improvements. The commission may by purchase, condemnation, donation, or otherwise secure land, flowage rights or easements required by the United States, and the state shall not be liable for expenses incurred. After acquisition, the Secretary of State shall convey any rights to the United States. The United States may also condemn lands under federal statutes and with commission cooperation. Condemnation for purposes of this chapter shall take priority over condemnation by other companies or agencies. The state retains concurrent jurisdiction with the United States over any land acquired and held under this chapter in order that civil or criminal process shall continue to issue on those premises. (Harris-Fla) W69-08160

PRELIMINARY PROVISIONS.

Del Code Ann tit 7, secs 4101-4104 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Drainage districts, *Flood protection, *Conservation, Drainage systems, Drainage programs, Legislation, Administrative agencies, Soil conservation, Wildlife conservation, Water conservation, Soil conservation, Public benefits, Public health.

It is declared that drainage and prevention of flooding of low or swampy lands is a public benefit and conducive to public health safety and welfare. The purpose of this chapter is to provide a basis for a uniform system of establishing drainage organizations under the supervision of the State Soil Conservation Commission in order to conserve soil, water, wildlife, forests and other resources. The terms 'benefits', 'landowners', 'taxable', and 'drainage' are defined. Any landowners served by a previously established drainage organization or who desire to have their lands drained or protected from flooding may petition for the establishment of a Tax Ditch pursuant to the provisions of this chapter. Assets and liabilities of existing drainage organizations may be transferred to the Tax Ditch. No drainage organization shall be established or reorganized except under this chapter. Existing organizations shall be governed by the laws under which they were organized unless they reorganize under this chapter. (Kahle-Fla) W69-08161

TAKING OYSTERS FROM CERTAIN WATERS. Del Code Ann tit 7, secs 2131-2134 (Supp 1966).

Descriptors: *Delaware, *Commercial shellfish, *Oysters, *Regulation, Legislation, Legal aspects, Water policy, Commercial fishing, Shellfish, Industries, Marine fisheries, Control, Fish harvest, Fish management, Water rights, Rivers, Tributaries. Identifiers: Limits, Seed oysters, Shellfish harvest.

With the exception of taking oysters for planting purposes, no oysters may be taken from Broadkiln

River of less than three inches in length and no boat may exceed twenty-five bushels of such legal oysters in a single day's catch. No oysters may be taken from the Mispillion or Murderkill Rivers until October 1, 1959, and then no more than fifteen bushels per day per boat. The annual season for taking oysters in these rivers extends from October 1 to March 31, inclusive. No seed oysters may be taken from the Mispillion or Murderkill Rivers or their tributaries. (Johnson-Fla) W69-08162

CONSERVATION.

Del Code Ann tit 7, secs 2301-2306 (Supp 1966).

Descriptors: *Delaware, *Crabs, *Clams, Regulation, Conservation, Fish conservation, Legislation, Permits, Dredging, Boats, State jurisdiction, Seasonal, Rivers, Bays, Fishing, Commercial fishing, Fishing gear.

No person shall sell or possess any crabs with eggs visible thereon or from which the egg pouch has been removed. Any US citizen may take hard shell crabs greater than four inches in length without a license: provided non-residents may not use more than four hand lines nor take more than 50 crabs per day. Crabs taken from the Indian River or Rehoboth Bay may not be sold. Possession of more than one bushel of hard shell crabs, other than peeler crabs, less than 5 1/2 inches is prohibited. Soft shell crabs less than 3 1/2 inches, and peeler crabs less than 3 inches, may not be taken or sold. Boats using a dredge to take crabs must be licensed for that purpose and must have been owned by a resident for at least one year or have been built within that time and have been owned continuously by a resident. A license must be obtained to take crabs in pots. Licenses will be reissued to residents who have lost a licensed vessel through accident. Crabs may not be taken by dredge from March 16 to December 15. Clams may not be taken in Rehoboth Bay or Indian River by dredge or any mechanical device. (Kahle-Fla)
W69-08163

POSSESSION OF CERTAIN MARINE LIFE. Del Code Ann tit 7, sec 1202 (Supp 1966).

Descriptors: *Delaware, *Commercial fishing, *Regulation, *Fish management, Legislation, Legal aspects, Fish, Marine fish, Fish conservation, Fisheries, Water policy.
Identifiers: *Marlin, *Sailfish, Marine game fish, Possession, Penalties (Criminal).

Atlantic sailfish, blue marlin, white marlin and striped marlin may not be possessed by any person with intent to sell nor may they be sold, purchased, delivered for shipment, or shipped from or within this state. Clearly marked and unbroken packages coming from other states or counties, showing the true origin and destination beyond the limits of this state are excepted from the above restrictions. Persons violating this section may be fined or imprisoned. (Johnson-Fla) W69-08164

HIGHWAYS (USE OF LANDS **UNDER** DELAWARE RIVER).

Del Code Ann tit 17, sec 408, 409 (Supp 1966).

Descriptors: *Delaware, *Delaware River, *River beds, *Bridge construction, Public utilities, Legislation, Administrative agencies, State governments, Beds under water, Land use, Public lands. Identifiers: *Delaware Memorial Bridge.

The state of Delaware consents to the use by the division of highways of all lands lying under the waters of the Delaware River which are within the state and are deemed necessary for the construction of the Delaware Memorial Bridge. (Gadd-Fla) W69-08165

For primary bibliographic entry see Field 05G. W69-08166 STATE BOARD OF HEALTH: WATER.

FLOOD CONTROL PROJECTS.

NH Rev Stat Ann secs 481-A:1, 481-B:1 thru 481-B:3, 481-A:1 (481-C:1) thru 481-A:3 (481-C:3) (1968).

Descriptors: *New Haaampshire, *Administrative agencies, *Water control, *Water policy, Dams, Water allocation (Policy), Water distribution (Applied), Legislation, Legal aspects, Water law, Project planning, Administration, Federal project policy, Edical icy, Federal government, Local governments, Management, Water rights, Appropriation, Riparian rights, Repairing, Flood control. Identifiers: *Water Resources Board.

The Water Resources Board may cooperate with the federal government under provisions of the Federal Flood Control Act of 1936 in the development of the Beaver Brook Flood Control Project. In order to carry out this project, the board may acquire necessary interests in land, arrange for relocation of highways and utility lines, and enter such other agreements with the city of Keene or the federal government. The board is authorized to accept conveyances of certain lands and water rights cept conveyances of certain rands and water rights along the Contoocook River and the Salmon Falls River for the purpose of improving and controlling such water rights for the benefit of the state. The board is also authorized to acquire certain listed dams and to repair and modify them in the best in-terests of the state. (Johnson-Fla) W69-08167

SEASONS, WATERS, LIMITS.

Vt Stat Ann tit 10, secs 121-122 (Supp 1968).

Descriptors: *Vermont, *Fishing, *Regulation, *Fish types, Seasonal, Trout, Bass, Pikes, Perches, Salmon, Lakes, Ponds, Rivers, Fish conservation, Fish management, Legislation. Identifiers: Pickerel, Smelt.

Certain listed lakes and ponds are designated as closed waters for all fishing except during the open season for trout. Except for certain tributaries of the Connecticut River and of Lake Champlain, all streams are closed trout waters except during the open season. The open season, minimum size limits, catch limits, and waters are listed for trout, salmon, pike perch, black bass, pickerel, and smelt. (Kahle-Fla) W69-08168

PROPAGATION AND CONTROL OF FISH AND WILD ANIMALS.

Vt Stat Ann tit 10, secs 4134, 4136-4140 (Supp 1968).

Descriptors: *Vermont, *Wildlife, *Conservation, *Reproduction, Fish reproduction, Breeding, Fish hatcheries, Wildlife conservation, Weirs, Animals, Water pollution, Ecology, Fishing, Mammals, Natural resources, Wildlife management, Fish management, Spawning, Legislation, Water law, Administrative agancies Administrative agencies. Identifiers: Fishways.

The Commissioner of Conservation shall have charge of the propagation and distribution of fish and wildlife. He shall provide for the operation of game farms, hatcheries, fishways and weirs. He may introduce fish into closed waters. He may transport fish and wildlife for the artificial propagation thereof for scientific and land managementpurposes. The commissioner may permit the taking of any harmful fish or wild animal. He may control aquatic vegetation and life in public waters. Any temporary pollution shall be done only upon notice to and in accordance with procedures of the State Water Resources Board. By agreement with the

Field 06—WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

owners thereof, the commissioner may close any private, noneboatable waters. Such waters while closed shall not be included in private preserves or propogation farms. During the spawning season of any fish species, the commissioner may close portions of waters used for spawning. Waters, except closed waters, stocked by the commissioner, shall be treated as public waters. The commissioner may designate certain waters as test waters to secure data on the propagation of fish. Such waters shall be posted, notice given of such use and regulated by the commissioner. (Helwig-Fla) W69-08169

AUTHORIZATION, CONSTRUCTION AND MAINTENANCE OF BRIDGES.

For primary bibliographic entry see Field 08A.

SUITS FOR INJURIES ON HIGHWAY.

SC Code Ann sec 33-921, 33-922, 33-925 (1962).

*South Carolina, Descriptors: *South Carolina, *Accidents, *Bridges, *Highways, Damages, Legislation, Road construction, Bridge failure, Regulation, Legal *Accidents, aspects, Boats.

Identifiers: Counties, Causeway, Ferries, Negligence, Tort liability

Any person receiving injury through a defect or negligent repair of a highway causeway or bridge or of a ferry operated by the county, occasioned by the neglect of a county, may collect damages if he were in no way guilty of contributory negligence. If death is caused by such a defect, the right of action for such injury and death shall survive to and may be enforced by the personal representative of the deceased. If it appears that the county had written notice of the defect before the accident occurred, then the burden of proof shall be on the county to show (1) that the defect did not in fact exist (2) that it had been properly repaired of (3) that a reasonable time in which to make repairs had not elapsed since such notice was received. (Shevin-W69-08171

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION).

For primary bibliographic entry see Field 05G. W69-08172

SEINES, TRAPS, OBSTRUCTIONS STREAMS, ETC GENERALLY.

SC Code Ann secs 28-607 thru 28-656 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Fish conservation. *Fishing, *Fish migration, Fish management, Nets, Fish ladders, Fish passages, Reasonable use, Dams, Legislation, Legal aspects, Water law, Sport fishing, Fish harvest, Sport fish, Water utilization, Regulation, Zoning, Control, Sluices, Water rights, Water sports, Recreation, Fishing gear, Local governments.
Identifiers: Penalties (Criminal).

Nets, traps, and other devices may be used to catch nongame fish in muddy inland waters. Such devices shall not be used from Saturday evening to Wednesday morning to take such fish. Special fishing regulations are set forth applicable to the respective game zones into which the state is divided. Other regulations deal with specific bodies of water. Most of these deal with the regulation of the use of certain fishing devices. For example, it is unlawful to take fish in game zone no. I by use of seines, and sport fishing there with rod and reel is regulated. Where seines are allowed, special regu-lations govern mesh size, length, etc. Game fish caught in nets must be immediately returned to the water from whence they came. No permanent obstruction, save dams for manufacturing purposes, may be placed in any waters of the state so as to obstruct free migration of fish. Dams on navigable streams must provide a fishway or ladder so that migratory fish may ascend upstream. The governing body of each county must designate the fish sluices on rivers so as to promote fish migration. There are seasons established for taking nongame fish in certain game zones. (Johnson-Fla) W69-08173

ETKIN V HYNEY (LEGAL CONSTRUCTION OF RESTRICTIVE COVENANT).

299 NYS2d 862-864 (1969)

Descriptors: *New York, *Reasonable use, *Recreation, Lake shores, Land use, Recreation facilities, Water law, Judicial decisions, Legal aspects, Leases, Swimming, Boating, Shores, Islands, Land tenure, Riparian rights. Identifiers: Restrictive convenants, Injunctions, Picnicking.

Defendant conveyed to plaintiff lands along a lakeshore upon which plaintiff constructed a dwelling. Defendant retained title to adjacent properties including a small island. In her conveyance to plaintiff, defendant restricted the use of the property to private residential uses only. Later, defendant constructed; on property nearby, six summer cottages and began to construct a road to permit access of her tenants to the lake shore and the island. The tenants and defendant's family used the island for picnicking, swimming and boating. Plaintiff sought to enjoin construction of the road and such use of the island, contending that these activities violated the restrictive covenant. The trial term held for defendant and the appellate division of the Supreme Court affirmed holding that the acts alleged were not inconsistent with the 'private residential uses' stipulated in the deed. (Carruthers-W69-08174

RELATIONS WITH FEDERAL GOVERNMENT; CERTAIN STATE-OWNED LANDS.

SC Code Ann secs 28-41 thru 28-47 (1962).

Descriptors: *South Carolina, *Federal government, *State governments, Administrative agencies, Recreation, Hunting, Fishing, Wildlife, Wildlife conservation, Wildlife management, Projects, Regulation, Land, Forests, Forestry, Forest management, National forests, Navigable waters, Game highs Fish Lighted States Game birds, Fish, United States. Identifiers: Santee-Cooper area.

Congress is given consent to make all rules deemed necessary by the Federal Government regarding birds, animals and fish on lands in South Carolina purchased by the United States under a certain congressional act of March 1, 1911. The South Carolina Wildlife Resources Department may enter Government for the protection of wildlife resources of the national forest lands within the state. The Director of the Division of Game may close all hunting and fishing within such lands for such period of time as he deems necessary. The director may also prescribe hunting and fishing seasons and fees for licenses therefore and other such rules. Any person violating the rules so promulgated shall be subject to fine or imprison-ment. These provisions shall apply also to other properties of the Federal Government and any other properties acquired therefrom by this state. Hunting and fishing is not allowed on lands con-trolled by the State Commission of Forestry, except by written agreement therewith. Funds collected on the Santee-Cooper area shall be used solely for game and fish protection in that area. The state assents to the act of Congress providing aid for wildlife projects. (Carruthers-Fla)

CAPITAL CANDY CO INC V CITY OF MONT-PELIER (FLOOD DAMAGE FROM DRAINAGE SYSTEM).

249 A2d 644-646 (Vt 1968).

Descriptors: *Vermont, *Flood damage, *Storm drains, *Cities, Damages, Drainage, Floods, Appropriation, Eminent domain, Judicial decisions, Legal aspects, Competing uses, Relative rights, Surface drainage, Drainage water, Storm drains, Storm runoff, Sewers, Drainage effects, Drainage practices, Watersheds (Basins), Preferences (Water rights), Public benefits, Public rights, Condemnation.

Identifiers: *Trespass, Negligence, Contributory negligence.

The plaintiff corporation brought an action for flood damage to warehouse merchandise as a result of defendant city changing its storm sewer system on adjacent land. The court affirmed a judgment for the plaintiff holding there was sufficient evidence that the city had caused the damage. The flooding of private land in the operation of municipal storm sewage system constituted appropriation of the land. The city was liable for this unlawful invasion of property. The fact that the drainage may have related to a public function did not excuse the neglectful trespass. The plaintiff had a right to improve and use his leasehold as it saw fit in spite of the probability of overflow. Plaintiff must have foreseen the damage with certainty to constitute contributory negligence on his part. W69-08176

BROWN V CITY OF JOLIET.

247 NE2d 47-52 (Ill App Ct 1969).

Descriptors: *Illinois, *Surface drainage, *Storm drains, *Cities, Planning, Judicial decision, Land use, Regulation, Drainage programs, Administra-tive agencies, Legal aspects, Project planning, Sewers, Surface runoff.

Identifiers: City of Joliet, Illinois, Subdivision plat, Planning commission.

Brown, a subdivision developer, sued to require the city of Joliet, Illinois to record her subdivision plat. Her plat had been down by the city planning commission and subsequently the city council because they felt she had failed to include adequate plans for surface runoff. The planning commission felt that development without adequate provision for storm drains would increase drainage problems in adjacent areas and would not drain her own development properly. Brown claimed that the requirement of more adequate provision for surface runoff was an illegal confiscation of her property. Judgment was entered for the city. The city had authority to make regulations for adequate water drainage before recording of a plat. There is a presumption of validity of these ordinances. There was sufficient evidence to show that Brown had not made adequate provision for surface drainage and that the city had acted properly under the ordinances. Brown was not deprived of property unconstitutionally as the problem required by the city to be remedied was a product of her own specific and unique activity. The problem was not one of the general community which the city is trying to force her to remedy at her own expense. (Gadd-Fla) W69-08177

MUNICIPAL PUBLIC WORKS.

For primary bibliographic entry see Field 04A. W69-08178

PUBLIC WORKS AUTHORIZED UNDER ARTI-

For primary bibliographic entry see Field 04A.

WATER-FRONT INPROVEMENTS.

SC Code Ann secs 59-561 thru 59-564 (1962).

Descriptors: *South Carolina, *Navigable waters, *Shores, *Condemnation, Legislation, Legal aspects, Cities, Tidal waters, Compensation, Eminent domain, Excavation, Condemnation value, City planning, Shore protection, Dredging, Wetlands, Land reclamation, Riparian rights, Public benefits, Area redevelopment. Identifiers: Nontidal waters.

Any city with a population of at least 50,000 may acquire all private property necessary to extend, improve, or protect its water front on a navigable stream, tidal or nontidal. This improvement must be for a public purpose. Sections 25-161 to 25-170 govern the acquisition procedure including just compensation. This right to acquisition includes the right to condemn. If the city desires to fill lowlands by excavating from the stream bed, the costs be a lien upon the land of the private owner. A city must give notice of the proposed filling to each private owner who may then fill the land at his own expense. If the owner objects to the cost of the filling, he may require the city to purchase the lot at an agreed price. If the parties cannot agree on a price, the city shall condemn the lot. (Breeze-Fla) W69-08180

LIGHTHOUSES AND OTHER AIDS TO NAVIGATION.

SC Code Ann secs 39-71, 39-72 (1962).

Descriptors: *South Carolina, *Lighthouses, *Federal-state water rights conflicts, *Jurisdiction, Navigable waters, Navigation, Riparian rights, Water policy, Ships, Buoys, Federal government, State governments, Legislation, Legal aspects, Ownership of beds, Beds under water, Federal jurisdiction, State jurisdiction. Identifiers: *Aids to navigation.

The governor may convey title to the US for state land covered by US navigable waters as the prospective site of some aid to navigation. An authorized US agent must make application and no single tract shall contain more than ten acres. The governor may also cede jurisdiction over the tract, but the state shall retain concurrent jurisdiction for service of process. (Breeze-Fla) W69-08181

SPECIFIC GRANTS OR CESSIONS.

SC Code Ann secs 39-108, 39-109, 39-117, 39-118 (1962).

Descriptors: *South Carolina, *Submerged lands, *Navigation, *Riparian land, Riparian waters, Land development, Legislation, Legal aspects, Water policy, Political aspects, Land use, Federal government, Navigable waters, Boundaries (Property), Ownership of beds, Navigable rivers, Military aspects, Coastal plains, Marshes, Tidal marshes, Bodies of water, Dredging, Channel improvement.

A large section of specifically described marshland which may be used to facilitate the improvement of inland navigation and which may be dredged, cut, filled, occupied and used at the direction of the Department of Defense or Congress, is granted to the United States. Another similar grant along Archer's Creek is made to facilitate improvements of navigation along the length of said creek. In Charleston County, certain lands including certain submerged lands near Cooper River, lands near Noisette Creek, and lands bounding the United States navy yard are ceded to the United States. Jurisdiction over these submerged lands in all cases not affecting the real and personal property of the United States remains with the state. Permission is given to deposit material dredged from certain of these lands as a result of channel improvements upon adjoining marshlands outside these grants. Such

grants are subject to any prior legal interests and rights of any person and the lands heretofore mentioned are free from taxes. (Johnson-Fla)

TRESPASSING ON PRIVATE DOCKS.

SC Code Ann secs 54-431 thru 54-434 (Supp 1968).

Descriptors: *South Carolina, *Docks, *Land tenure, *Regulation, Public rights, Permits, Legislation, Federal government, State governments, Administrative agencies, Bodies of water, Jurisdiction.

Identifiers: *Trespass, Notice, Private rights, Criminal penalties.

Trespassing or attaching a boat or other device to any privately owned dock on public or private waters shall be a misdemeanor, provided the owner has posted a conspicuously placed notice worded 'trespassing on this dock is prohibited by law.' This act does not apply to docking facilities open to the general public or private facilities used in emergencies, with implied or expressed permission of the owner, or in the performance of duties arising out of state or federal charters, licenses or franchises. This chapter shall not prevent or interfere with the right of any person, governmental body, commission or agency to regulate and control activities on waters and adjoining lands under their jurisdiction. (Harris-Fla)

ARKANSAS STATE HIGHWAY COMM V CARRUTHERS (DAMAGES IN EMINENT DOMAIN PROCEEDING).

439 SW2d 40-41 (Ark 1969).

Descriptors: *Arkansas, *Eminent domain, *Compensation, *Highway construction, Cost repayment, Condemnation value, Judicial decisions, Bridge construction, Land tenure, Damages, Leases, Access routes. Identifiers: *Evidence.

The Arkansas State Highway Commission brought an eminent domain proceeding against appellees for the acquisition of lands needed for highway construction. On trial, the jury returned a \$45,000 verdict in favor of appellees. At the trial the landowners testified to the estimated cost of constructing a bridge to provide access to a portion of their land after the taking. Appellee's witnesses also testified to damages to an airstrip which they were leasing. Appellant alleged error in the admission of this evidence. On appeal the Supreme Court of Arkansas held that the owner's testimony of a contractor's estimate was heresay and not expert testimony. The court also held when property is under lease at the time of the condemnation, the owner's damages are confined to the reversion--not the leasehold estate. (Harris-Fla)

ROCKEFELLER V HOGUE (REMOVAL OF GAME AND FISH COMMISSIONERS).

439 SW2d 805-813 (Ark 1969).

Descriptors: *Arkansas, *State governments, *Administrative agencies, *Adjudication procedure, Administration, Governments, Judicial decisions, Jurisdiction, Legal aspects, Decision making, Political aspects, Personnel management. Identifiers: State constitutions, Injunctions.

The governor of the state sought to remove two members of the Game and Fish Commission. He appointed a panel to hear the charges and to present the record to him. The commissioners obtained an injunction in the Chancery Court enjoining the hearing and the governor appealed. The commissioners had been appointed pursuant to the state constitution which also provided for their

removal from office by the governor after a hearing. The hearing was subject to review by the Chancery Court and appeal to the state Supreme Court. The court interpreted this provision of the constitution to mean a commissioner removed by the governor was entitled to a new trial on the merits without regard to any error in proceedings before the governor. The court held that the commissioners had a full and adequate remedy at law and the Chancery Court was without jurisdiction to issue the injunction. There are two concurring opinions. (Helwig-Fla) W69-08185

STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY.

17 SC Code Ann 190 (1962).

Descriptors: *South Carolina, *Potable water, *Industrial water, *Water quality control, Water storage, Storage tanks, Water supply, Public health, Water pollution, Water requirements, Legislation, Corrosion, Administrative agencies. Identifiers: *State Board of Health, *Food processing, Water quantities.

Water meeting all requirements of the State Board of Health as to drinking water shall be easily accessible to all parts of food processing rooms. Any industrial water used at a processing plant shall have no connection with potable water used for food manufacturing. Non-potable water shall not be piped into food processing rooms. The water accessible should be of sanitary quality to avoid contamination of food and equipment. The water shall also be supplied in sufficient quantities to complete all cleaning necessary. Water storage tanks should be corrosion resistent, and protected from contamination. (Harris-Fla) W69-08186

STATE BOARD OF HEALTH, RAILROADS, WATER AND ICE SUPPLIES.

17 SC Code Ann 235 (1962).

Descriptors: *South Carolina, *Potable water, *Water quality, *Railroads, Ice, Coolants, Domestic water, Transportation, Public health, Human diseases, Water purification, Water storage, Water supply, Legislation, Interstate, Administrative agencies.

ministrative agencies.
Identifiers: *US public health service, Certified water, Interstate quarantine.

Water provided for drinking or cooking in railway trains or stations must be certified by the United States public health service as meeting interstate quarantine regulations of the United States. Ice used to cool such water must be clear, natural ice made from distilled or certified water. If such ice contacts the water, it must first be washed and handled so as not to contaminate the water with infectious organisms. Ice not contacting the water need not meet these standards, and all newly constructed railroad cars shall be made so that cooling ice does not contact the water. When water and ice are put in the same compartment, the tank shall be cleaned each week it is in use, and drained and flushed at least once a month. Portable tubing used to fill drinking water containers shall have smooth metal nozzles protected from dirt and contamination. Such tubing shall be flushed prior to each filling. (Harris-Fla)

MOHESKY V CITY OF WASHINGTON (FLOOD DAMAGE CAUSED BY STREET IMPROVEMENT).

432 SW2d 364-367 (Ct App Mo 1968).

Descriptors: *Missouri, *Floods, *Flow augmentation, *Highway effects, Highways, Construction, Drainage, Damages, Local governments, Adjudica-

Field 06—WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

tion procedure, Remedies, Judicial decisions, Obstruction to flow, Alteration of flow.

Plaintiffs brought an action for damages against the city and its engineer because their raising of the grade of a street in front of plaintiffs' property caused increased flowage on plaintiffs' land, flooded plaintiffs' basement, and hindered part of their land inaccessible from the street. A new trial was granted the city on grounds of excessiveness of the \$3,500 verdict awarded plaintiffs. On appeal by plaintiffs, the trial court's action in granting the new trial was upheld. The appellate court could not weigh the evidence, but only determine whether there was evidence that reasonable supported the trial court's decision. (Kahle-Fla) W69-08188

STATE V CORE BANKS CLUB PROPERTIES INC (CONDEMNATION OF LAND FOR USE AS NATIONAL PARK). 167 SE2d 385-392 (NC 1969).

Descriptors: *North Carolina, *Condemnation, *National parks, *Seashores, Land use, State governments, Administrative agencies, Federal government, Legislation, Judicial decisions, Adjudication procedure, Public benefits.

Plaintiff, state of North Carolina, acting through its Department of Administration, sought to condemn defendant's shoreline property in order to convey it to the United States for a national park. The court held that such condemnation would be for a proper public purpose, since some benefit would accrue to the state. A statute granting the Department of Administration the power of eminent domain, how-ever, did not authorize that agency to decide public purpose or initiate state projects utilizing the power of eminent domain. The statute merely appointed the department as an acquisition agent for the state. Since no express legislation authorized the department to condemn seashore property in order to convey the same to the United States, the department was without power to condemn defendant's land. (Kahle-Fla) W69-08189

CITY OF LOUISVILLE V LOUISVILLE SEED COMPANY (MUNICIPAL TORT LIABILITY FOR FLOOD DAMAGE). 433 SW2d 638-644 (Ky 1968).

Descriptors: *Kentucky, *Floods, *Flood damage, *Local governments, Remedies, Damages, Adjudication procedure, Judicial decisions, Floodgates, Flood control, Public benefits, Cities. Identifiers: *Municipal tort liability.

Plaintiff was awarded damages for an injury allegedly caused by flood waters resulting from defendant city's failure to install flood gates in the municipal flood wall system. On appeal, the judgment was reversed. The court held that a city could not be held liable in tort for a risk which was inherently part of the function of government. The city was not legally required to engage in the maintenance of flood control facilities. A city can be held liable only where it deals with a party on an individual basis, rather than as a member of the general public. Flood control facilities were beneficial to the entire citizenry and plaintiff's damage could not be separated from damages occasioned by the general public. (Kahle-Fla) W69-08190

BALDWIN V'ANDERSON (TITLE TO LAND FORMED BY AVULSION OR ACCRETION).

40 Wis 2d 33, 161 NW2d 553-560 (1968).

Descriptors: *Wisconsin, *Accretion aspects), *Avulsion, Land forming, Land tenure, Land classification, Rivers, Boundaries (Property), Judicial decisions, Legal aspects, Water law, Watercourses (Legal), Boundary disputes, Riparian land, Riparian rights. Identifiers: Doctrine of 'doubtful title'.

The sellers of a farm, one original boundary of which was a river, brought an action to collect on a note given by the buyers as earnest money for the proposed sale. The lower court dismissed the complaint and the sellers appealed. When the sale had been completed it was not known whether the river originally forming the southern boundary of the property had shifted its course through accretion or avulsion. Therefore, it was not known whether title to the newly formed land was in the owners of the farm or in a riparian owner of lands originally north of the river. The buyers, believing that there was reasonable doubt of merchantable title refused to close the transaction. The court, after defining avulsion and accretion and discussing their effects on land ownership, held that there was reasonable doubt whether title to the farm was merchantable and the purchasers were justified in refusing to close the transaction. (Carruthers-Fla) W69-08191

SMITH V BOARD OF COUNTY ROAD COMMISSIONERS OF CHIPPEWA COUNTY (FLOOD DAMAGE CAUSED BY ROAD CON-STRUCTION AND ACT OF GOD).

381 Mich 363, 161 NW2d 561-569 (1968).

*Michigan, *Highway Descriptors: *Floods, *Rain water, Basins, Rainfall, Alteration of flow, Obstruction to flow, Damages, Remedies, Ravines, Judicial decisions, Adjudication procedure, Roads, Local governments, Flood damage Identifiers: *Act of God.

Plaintiff, landowner, brought an action in trespass for flood damages allegedly caused by defendants, county road commissioners, changing of the road level near a basin. Plaintiff charged that the altered road level was a contributing and concurring cause of water breaking through and washing out a road on the opposite side of the basin and washing plaintiff's residence and inhabitants into a large ravine created by the water. The sole issue was whether plaintiff's damages were caused solely by an act of God, torrential rainfall, or whether defendants' act was a contributing cause which would render them liable. Upon judgment for defendant and appeal by plaintiff the appellate court upheld the trial court's decision that the issue was one solely for jury determination. The Supreme Court affirmed the appellate court's decision. The dissent felt that there could be no finding that defendants were not contributorily causative and would have reversed solely on the issue of damages. (Kahle-Fla) W69-08192

POWERS OF THE GOVERNOR AND COUNCIL.

NH Rev Stat Ann secs 4:10 (1955), 4:40-A, 4:40-B, 4:40-C, 4:40-D (Supp 1967).

Descriptors: *New Hampshire, *Beds under water, *Ownership of beds, *Interstate rivers, Political aspects, Legislation, Administrative agencies, Administrative decisions, Water law, Water policy, Legal aspects, Ponds, Navigable waters, Streambeds, Sands, Gravels, Water management (Applied), Public rights, Diversion, Rivers, Financing, Water resources. Identifiers: *Deeds Identifiers: *Deeds.

The governor may institute suits in the name of the state when, in his judgment, they are necessary to prevent the injurious diversion of the water of rivers which naturally flow from other states into New Hampshire. After consultation with the fish and game commission and other state agencies as may be involved the governor and counsel upon just consideration may convey sand and gravel which is on the bed of any navigable water or great pond. A great pond is any public water of more than ten acres. Petition for such conveyance is considered by the water resources board and, upon approval by it, the governor has an appropriate deed prepared. The board's recommendation includes all appropriate specifications and conditions necessary to the protection of public and private rights.

Consideration paid for taking sand or gravel is credited by the state treasurer to the appropriation for the water resources board. (Johnson-Fla) W69-08193

POWERS AND DUTIES OF TOWNS.

NH Rev Stat Ann sec 31:4 (1955), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Local governments, *Dams, *Flood control, Legislation, Legal aspects, Water law, Water policy, Interstate compacts, Federal government, Recreation, Recreation facilities, Financing, Economics, Political aspects, Waste disposal, Cities, Projects.

Within New Hampshire, the power of towns to raise and appropriate money is derived solely from statutory provisions which restrict this power to such areas as the following: dams, collection and removal of waste materials, and federal or interstate flood control projects. Towns may acquire, construct, control and operate dams at the outlet of any body of water when such action will improve the recreational value of such body of water. Towns must provide means for collection, removal and destruction of garbage and other waste materials. Towns acting jointly or separately in order to protect their interests with respect to federal flood control projects, etc may make necessary appropriations for such purposes. (Johnson-Fla) W69-08194

PROTECTION OF WATER SUPPLY. NH Rev Stat Ann sec 38:21 (Supp 1967).

Descriptors: *New Hampshire, *Water sources, *Eminent domain, *Local governments, Legal aspects, Water law, Water policy, Legislation, Judicial decisions, Priorities, Preferences (Water rights), Water, Water costs, Water quality, Adjudication procedure, Prescriptive rights, Jurisdiction, Relative rights, Cities, Domestic water.

Any municipality or water company supplying water to the public for domestic use has the power to exercise the right of eminent domain over any property needed to protect the purity of such water supply. Such power is exercised by petition to the superior court or, in the case of a village district, to the board of selectmen of the town or towns within which the district is situated. Proceedings thereon are identical to those where there is a petition for laying out a highway. (Johnson-Fla) W69-08195

IMPROVEMENT OF SWAMP LANDS. NH Rev Stat Ann secs 431:1 thru 431:5 (1968).

Descriptors: *New Hampshire, *Swamps, *Land Descriptors: "New Hampshire, "Swamps, "Land reclamation, Landfills, Adoption of practices, Economics, Financing, Legislation, Administrative agencies, Legal aspects, Natural resources, Soil management, Land development, Conservation, Drainage, Drainage practices, Wetlands, Land forming, Public health, Land use, Land management, Marshes.

Identifiers: Swamp lands.

Selectmen, upon petition, may cause any low or swamp lands within their town to be drained or filled when the public health or good, or the advancement of agriculture, requires it. They may lay out or take such land, easements, or rights and land as may be necessary for the purpose. Damages may be awarded to any owner of land so taken, but these must be set off against any benefit accruing to him from the improvement. Persons benefited are to be assessed to the extent of the benefit to them. Such assessments have the same effect, may be abated or corrected and shall be collected in the same way, as in the case of assessments for side-walks and sewers. (Johnson-Fla)

W69-08196

HARBORS AND PUBLIC WATERS.

NH Rev Stat Ann secs 271:8 thru 271:21 (1966).

Descriptors: *New Hampshire, *Harbors, *Water pollution, *Navigable waters, Public rights, Pollutants, Pollution abatement, Streams, Ponds, Land tenure, Riparian rights, Ice, Navigation, Legisla-tion, Fresh water, Legal aspects, Marking techniques, Water pollution control, Water pollution sources.

Dumping, Ice harvesting, Public Identifiers: highways, Public waters.

If any person shall unload, cast or throw out of any ship, vessel or boat, or from shore or wharf, any ballast or other filth into the harbor, he shall forfeit not more than ten dollars. Navigable streams or waters are those which are used, or are susceptible of being used in their ordinary condition, as highways of commerce, over which trade or travel is or may be conducted in the present customary modes of trade or travel on water, and such term shall not apply to streams or waters which are used merely as public highways for floating logs. Anyone harvesting ice on any public waters shall put up suitable markers indicating the area of harvest. Anyone who violates this provision shall be fined one hundred dollars, or imprisoned not more than 90 days, or both. All natural bodies of fresh water which have an area of twenty acres or more are public waters. The state holds all public waters in trust for the public use. No person or corporation shall have or exercise in any public waters any rights or privileges not common to all citizens of this state. (Gadd-Fla) W69-08197

BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMM'N (WATER DAMAGE FROM DIVERSION).

For primary bibliographic entry see Field 04C. W69-08311

HACKENSACK WATER COMPANY V VILLAGE OF NYACK (ACTION TO RECOVER FOR WITHDRAWAL LOSS).

For primary bibliographic entry see Field 04C. W69-08312

SEWERAGE AUTHORITIES LAW. For primary bibliographic entry see Field 05G. W69-08313

LAYING OUT, ALTERING AND DISCONTINU-ING HIGHWAYS.

For primary bibliographic entry see Field 04C. W69-08314

JURISDICTION OVER OFFSHORE WATERS AND SUBMERGED LANDS.

Me Rev Stat Ann tit 1, secs 2, 3, 13, 14, 15 (1965); Me Rev Stat Ann tit 1, sec 27 (Supp 1968-69).

*Jurisdiction, *Beds, *Oceans. Descriptors: *Maine, Legislation, Legal aspects, Ownership of beds, United States, Condemnation, Surveys, Islands, Great ponds, Tidal waters, Water rights, State governments, Eminent domain, Federal

government, Jurisdiction. Identifiers: Offshore waters, Navigation aids, Marginal sea, High sea.

Maine's jurisdiction over offshore waters shall extend as follows: over the outermost limits of the marginal sea as recognized by the United States; over the high seas to the extent jurisdiction is claimed by the United States; and over all submerged lands lying under these waters. The ownership of the waters and submerged lands described above shall be in the state. The Governor, when

required by public exigencies, may acquire lands or rights of way for fortifications or the erection of navigation aids. Jurisdiction or possession of such lands may be given to the United States. A survey of the land to be taken must be made. The filing of the plan with the Secretary of State shall vest title to the land in the state. The title to all islands in great ponds and title to all islands located in the sea within the jurisdiction of the state shall remain in the state and not be sold. (Childs-Fla) W69-08315

STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JU-RISDICTION OF AEC).

For primary bibliographic entry see Field 05G.

DIVISION OF PARKS AND RECREATION.

Minn Stat Ann secs 85.20, 8532 (1964).

*Boating, *Minnesota, *Parks, Descriptors: *Recreational facilities, Camp sites, Fishing, Forest management, Hunting, Lakes, Land use, National parks, Recreation, Scenery, Landscaping, Lumber, Wildlife, Fish, Streams, Water levels, Damages, Boating regulation, Rivers, Navigation, Dams, Waterfalls, Eddies, Easements, Legislation. Identifiers: Trespass, Misdemeanor, Penalties, Portages, Rapids, Hazards to navigation.

Any person who cuts, injures, or takes any tree, timber, or plant in Itasca State Park, or kills or hunts any wild animal, or who, without the consent of the director, takes any fish from the waters, raises or lowers any lake or stream in the park, or sets any fire in the park, or damages any building or property of the state therein, shall be guilty of a misdemeanor and the minimum punishment shall be a \$50 fine. The commissioner of conservation is authorized to mark canoe and boating routes along the rivers of the state which have historic and scenic values. He may mark points of interest and camp sites and all dams, rapids, waterfalls, whirlpools, and other hazards which are dangerous to canoeing. The commissioner may take land by easements and by leases to make camp sites along the routes of the river. (Shevin-Fla) W69-08317

MICHALKA V GREAT NORTHERN PAPER COMPANY (FLOOD DAMAGE).

For primary bibliographic entry see Field 04A. W69-08318

LUENING V PUBLIC SERVICE COMMISSION (PERMIT TO CONSTRUCT HYDROELECTRIC

For primary bibliographic entry see Field 8C. W69-08319

CONSTRUCTION AND REPAIR OF BRIDGES

AND DRAINAGE SYSTEMS.
For primary bibliographic entry see Field 04A.
W69-08320

SIONER (COMPENSATION FOR CONDEMNA-TION OF A SPRING AND AN EASEMENT). For primary bibliographic entry see Field 04C. W69-08321 CAMPBELL V STATE HIGHWAY COMMIS-

GUESS V AZAR (RIGHT OF WAY ACROSS PRIVATE PROPERTY).

57 So 2d 443-445 (Fla 1952).

Descriptors: *Florida, *Easements, *Right-of-way, *Access routes, Beaches, Shores, Gulf of Mexico, Bays, Intertidal areas, Tides, High water mark, Low

water mark, Transportation, Roads, Barriers, Legal aspects, Judicial decisions, Navigable waters, Farms, Livestock, Public benefits, Land tenure, Remedies.

Identifiers: Ingress, Egress, Shells, Contempt of court, Injunction (Prohibitory).

The plaintiff's land was bounded on one side by the Gulf of Mexico and on the other side by Sarasota Bay. Defendant's land adjoined plaintiff's land and his only access was along the foreshore or over plaintiff's land. Plaintiffs sought an injunction to prevent the defendant from hauling shell across their land. The lower court granted the relief plain-tiffs requested. The defendant violated the injunction and was adjudged in contempt. In his order the chancellor stated that the defendant had a statutory right of way over plaintiff's land for the purpose of home, argicultural and stock raising, but for no other purpose. All other purposes would be in other purpose. All other purposes would be in violation of the injunction. On appeal the court said that the defendant had no right to violate the chancellor's order. The court held the chancellor to be correct in limiting the route for removal of shell to the foreshore, as the foreshore by its very nature was available to the public for access. The court held this condition must exist until a public road across plaintiff's property was opened. (Shevin-W69-08322

GAINESVILLE STONE CO V PARKER (DAMAGE TO LAND BY FLOODING CAUSED BY IMPROPER DAM MAINTENANCE). For primary bibliographic entry see Field 04A.

PARISH OF EAST BATON ROUGE V BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION). For primary bibliographic entry see Field 04A. W69-08324

INTERSTATE WATER COMPACT.

Conn Gen Stat Ann, Secs 25-122 to 25-125 (Supp

Descriptors: *Connecticut, *Interstate compacts, *Administrative agencies, *Water supply, Legislation, Interstate rivers, Interstate commissions, Cities, State governments, Water delivery, Water dis-tribution, Applied distribution systems, Investigations, Projects, Governors

Identifiers: Connecticut Interstate Water Compact

The governor is authorized to enter into a compact with other states to collect, transport, and dis-tribute water for use by the state's municipalities. Every agency, board, commission, or administrative group shall make their records, information, and research available to the governor without charge. The Connecticut Interstate Water Compact Commission is created to assist the governor in determining the advisability of entering such compact. (Stewart-Fla) W69-08325

WILDLIFE MANAGEMENT.

W Va Code Ann, Sec 20-2-3, 20-2-5, 1966, as amended (Supp 1968).

Descriptors: *West Virginia, *Administrative agencies, *Wildlife conservations, *Fishing, Sport fishing, Aquatic life, Legislations, Regulation, Fish management, Fish migration, Fishkill, Toxins, Navigable waters, Ponds, Lake, Permits, Fish conservation, Explosives. Identifiers: Felonies.

The ownership and title to all wild animals and birds, both migratory and resident, and all fish is in the state as trustee for the people; however, all fish

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

in private ponds are the private property of the pond owners. It is unlawful for any person to have any hunting or fishing gear which cannot be lawfully used in this state. Conservation officers are authorized to confiscate or destroy any such gear which they find. It is also unlawful to catch, take, kill or attempt to catch any fish at any time except by rod, line, and hooks unless otherwise authorized. It is unlawful to use any explosive or poison in state waters to kill or catch fish. Violation of this provision is a felony. Fish located in state waters are subject to regulations by the state while those in private ponds may be caught at any time. (Stewart-Fla)

POWERS AND DUTIES OF CONSERVATION OFFICERS.

W Va Code Ann sec 20-7-4 (1966).

Descriptors: *West Virginia, *Legislation, *Wildlife conservation, Natural resources, Forests, Parks, State governments, Legal aspects, Conservation, Administrative agencies, Local governments, Recreation, Fishing, Hunting, Fishing gear.

Conservation officers shall be supervised and directed by the director of the Department of Conservation in the performance of their duties. The authority and duties of the conservation officers shall be statewide and they shall have authority to: (1) arrest without a warrant any person detected by them in the violation of any of the provisions of this chapter except where otherwise provided, (2) carry arms and weapons, (3) search and examine, in the manner provided by law, any boat, vehicle, etc or any other place where hunting and fishing equipment or wildlife could be concealed when they have probable cause to do so, (4) execute and serve any process of law issued under authority of this chapter, or copies of orders made and entered by the chief of the division of water resources, (5) to stop any motor vehicle for the purpose of conducting game-kill surveys, (6) summon aid in making arrests or seizures, (7) enter private lands or waters while performing their official duties, (8) arrest on sight, subject to limitations, any person committing a criminal offense on national forest lands, (9) do all things necessary to carryout these provisions. (Carruthers-Fla) W69-08327

RIVERS AND STREAMS AS LAWFUL FENCES. W Va Code Ann sec 19-17-2 (1966) as amended, (Supp 1968).

Descriptors: *West Virginia, *Rivers, *Streams, *Riparian rights, Legislation, Boundaries (Property), River regulation, Barriers, Land tenure, Adjudication procedure, Legal aspects. Identifiers: *Fences, Counties, Notice, Publication.

All rivers and streams that are lawful fences at the effective date of this statute shall continue to be so until otherwise ordered by the county court. The county court, upon application from the owner or tenant of lands on a river or stream constituting a boundary line of the county may declare and establish such river or stream to be a lawful fence. Notice of the application must be given by publication in the county, and interested parties may appear to oppose the application. The court may also annul or amend any previous order establishing a river or stream as a lawful fence; however, such revocation cannot be made within one year after the date of the order to be annuled, and shall not take effect until six months after it is made. (Shevin-Fla)

THE MARITIME BOUNDARIES OF THE STATES, Avrum M. Gross. Mich L Rev, vol 64, No 3, pp 639-670, Jan 1966. 32 p, 132 Ref.

Descriptors: *Law of the sea, *Submerged Lands Act, *International waters, Boundaries (Property), Ownership of beds, State governments, Federal government, Low water mark, International law, Inland waterways, Legislation, Shores, Coasts, Political aspects, Commercial fishing, Seashores, Bays, Inlets (Waterways), Boundaries (Surfaces), Locating, Water law, Legal aspects, Conferences, Watercourses (Legal), Federal-state water rights conflicts.

Identifiers: *Marginal seas, *Historical waters, Maritime areas.

While it has long been recognized that the seaward boundaries of coastal states encompass certain adjoining maritime areas, confusion over their precise location has engendered dispute. The First Law of the Sea Conference, convened at Geneva in 1958, helped to reduce these differences by establishing international norms for boundary delineation. A need for such norms also existed on the federal level in the United States. In an attempt to reduce disputes between the federal and state governments, Congress passed the Submerged Lands Act which granted the states title to all lands under navigable waters within a set distance from their coast as measured from the low water mark or the seaward limit of the inland waters. But in the absence of the establishment of standards regarding the location and extent of 'inland waters', uncertainty still remained. Finally, the Supreme Court was called upon to interpret this act. They adopted the standards agreed upon at the Geneva Convention as a workable definition of 'inland waters. While boundary delineation problems will continue to arise within the Federal area, the adoption by the court of objective standards supported by international consensus has helped create a framework for orderly division of maritime jurisdiction between state and federal authorities. (Gabrielson-Fla) W69-08329

POWER TO CROSS ROADS, HIGHWAYS AND STREAMS; CROSSING CANALS OR NAVIGABLE WATERS.

Md Ann Code Art 23, secs 203, 206 (1966), as amended, (Supp 1968).

Descriptors: *Maryland, *Railroads, *Streams, Bridges, Canals, Administrative agencies, Administrative decisions, Navigable waters, Nonnavigable waters, Roads, Highways, Transportation, Road construction, Streambeds, Diversion, Diversion structures, Legislation, Regulation, Legal aspects, Eminent domain, Railroad relocation, Engineering structures, Piers, Bridge design. Identifiers: Crossings, Free passage.

Any railroad, in the construction of its road, may cross any road, highway or stream and divert the stream provided it be non-navigable. It is lawful for any railroad corporation whose railroad crosses a road or highway to carry the same over its tracks by an overgrade crossing or under its tracks by an un-dergrade crossing. The road or highway can be diverted from its existing location and the railroad can use appropriate legal processes if necessary to appropriate buildings, gardens or yards concomitant to such diversion. The railroad shall promptly replace such road, highway or stream so as not to impair its former usefulness. Such railroad will be liable for any damages caused by stream diversion. Whenever the line of any railroad company crosses any navigable water, said company shall file with the Board of Public Works the plan of fixtures to be utilized in the crossing. The Board's approval shall be in writing. If the kboard disapproves the plan, recourse can be had by the railroad in the circuit court which can appoint a disinterested engineer to prescribe a plan and can then issue an order of confirmation. But no railroad company can construct any permanent bridge less than 12 feet above the top water line, nor shall any piers or abuttments be placed so as to interfere with free passage. (Carruthers-Fla) W69-08330

FUND FOR WATERWAY IMPROVEMENT PROJECTS IN CHARLES COUNTY; BUILDING ACROSS NAVIGABLE RIVER PROHIBITED.

Md Ann Code Art 25, secs 3 (bb), 49 (1957), as amended (Supp 1968).

Descriptors: *Maryland, *Water management (Applied), *Navigable rivers, *Channel improvement, Bridges, Administrative agencies, Legislation, Legal aspects, Public benefits, Expenditures, Separable cost allocation, Mosquitoes, Breakwaters, Navigable waters. Identifiers: Drawbridge.

The County Commissioners of Charles County are authorized to maintain a \$40,000 fund to provide for channel improvement, breakwater construction, mosquito control and other waterway improvement projects in county waters; however, nothing in this article authorizes any county commissioners to build any bridge or drawbridge across any navigable river. (Carruthers-Fla) W69-08331

PUBLIC LANDINGS.

Md Ann Code Art 25, secs 156, 157 (1957), as amended, (Supp 1968).

Descriptors: *Maryland, *Public benefits, *Recreation facilities, Navigable waters, Recreation, Navigable rivers, Canals, Bays, Administrative agencies, Permits, Roads, Local governments. Identifiers: *Public landing, Sounds, Public convenience, Application.

Where public convenience so requires, the county commissioners are empowered to establish a public landing on any navigable waters in the county. Applications for the establishment of such a public landing shall be handled by the same proceedings as that for applications to open a public road; but the procedures in this section shall not be applicable in Queen Anne's County. (Carruthers-Fla) W69-08332

SHORE EROSION CONTROL DISTRICTS. For primary bibliographic entry see Field 04D. W69-08333

CONSERVATION OF WATER. For primary bibliographic entry see Field 04A. W69-08334

NATURAL RESOURCES.

Md Ann Code Art 66C secs 25, 27, 30 (1957).

Descriptors: *Maryland, *Administrative agencies, *Mining, *Regulation, Water policy, Legal aspects, Legislation, State governments, Permits, Financing, Taxes, Tax rate, Ownership of beds, Beds, Beds under water, Riparian rights, Navigation, Navigable waters, Natural resources, Soils, Royalties. Identifiers: Rare earths, Minerals.

Persons or business entities desiring to extract rare earth and minerals from the public lands under the Chesapeake Bay must apply to the Board of Natural Resources of the State. Applications must include a description of the land and, where practicable, stakes should be driven in order that a survey may be made. Both the Board of Natural Resources and the Board of Public Works must approve such application. The discoverer of the location of rare earths and minerals is given preference as against other applicants. Permits and leases will contain such regulations as are deemed necessary for the protection of navigation channels and other interests of the state. Permits may not be granted for certain areas. Although the royalty per ton of minerals or rare earth may be changed by the legislature from time to time, the rights of riparian owners shall not in any way be invalidated. (Johnson-Fla)

W69-08335

SOIL CONSERVATION DISTRICTS. For primary bibliographic entry see Field 04D. W69-08336

WIDENING. RUNS; CREEKS STRAIGHTENING, ETC. For primary bibliographic entry see Field 04A.

W69-08337

STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. For primary bibliographic entry see Field 04C. W69-08338

CONSTRUCTION OF IMPROVEMENT. For primary bibliographic entry see Field 04A. W69-08339

PROCEDURE TO ESTABLISH DISTRICTS. For primary bibliographic entry see Field 04A. W69-08340

AND DAMAGE FLOATING TIMBER THEREFROM. For primary bibliographic entry see Field 04C.

W69-08341

EXCAVATING AND DREDGING IN PUBLIC WATERS.

For primary bibliographic entry see Field 04A. W69-08342

TIDAL WATERS.

For primary bibliographic entry see Field 04A. W69-08343

LIMITATION OF HYDRO-ELECTRIC CHAR-

NH Rev Stat Ann secs 483:1, 483:2 (1968).

Descriptors: *New Hampshire, *Hydroelectric plants, *Hydroelectric project licensing, *Dams plants, "Hydroelectric project licensing, Dams, Dam construction, Legislation, Remedies, Mill dams, Powerplants, Construction, Streams, Over-flow, Reservoirs, Water law, Legal aspects, Water utilization, Permits, Limiting factors, Judicial decisions, Flow, Flow control.

Identifiers: Penalties (Civil), Forfeiture.

All rights, powers, privileges and franchises con-ferred upon any corporation enabling it to con-struct and maintain mill dams or overflow lands for hydroelectric purposes shall be forfeited unless ac-tual construction work thereon has commenced within six years of the conferring of such rights and the same prosecuted with reasonable diligence thereafter until such structures are completed. If any of the above stipulations are not met and fol-lowed any private citizen may file a written complaint with the attorney general setting forth a breach of the above. It shall be the duty of the attorney general to enforce by an appropriate proceeding, a forfeiture of the rights, powers, privileges and franchises under which the corpora-tion might have erected its dam or plant. (Holt-Fla)

DAMS AND FLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE WATER RESOURCES BOARD). For primary bibliographic entry see Field 04A. W69-08345

PLACING FILL IN PUBLIC WATERS. For primary bibliographic entry see Field 04A. W69-08346

EOUIPMENT AND OPERATION OF VESSELS.

SC Code Ann secs 70-295 thru 70-295.17 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Boats, *Safety, *Boating regulations, Regulation, Water skiing, Standards, Legislation, Recreation, Safety factors, State jurisdiction, Navigable waters, Permits, Accidents, Marinas.

Identifiers: Flotation standards, Negligent operation, Alcohol, Drugs, Penalties (Fines), Penalties

(Imprisonment).

The provisions herein apply to any vessel operated on waters of this state. The administration of this chapter is vested in the Wildlife Resources Department which shall set up a Division of Boating and carry out a program of safety education and training for law enforcement officers. No vessel not already in the hands of a dealer, other than one constructed of wood, shall be sold after January 1, 1962, unless its serial number is imprinted on the transom and unless it meets flotation standards of the Division. Owners of boat liveries must keep records for 6 months of the names and address of persons hiring vessels, identification number of the boat, departure time and expected time of return. Boats or water skis shall not be operated negligently or while the operator is under the influence of alcohol or drugs. The owner of a vessel is liable for its negligent operation unless such vessel is used without his express or implied consent. An operator of a vessel involved in an accident must render aid, leave his name and address, and where damage exceeds \$100 or death occurs, file a report with the Division. Fines and imprisonment are imposed for violation of these provisions which may be enforced by any peace officer of the state. (Kahle-Fla) W69-08347

PROTECTING WATER AND ICE SOURCES. For primary bibliographic entry see Field 05G.

PROTECTING WATER AND ICE SOURCES. For primary bibliographic entry see Field 05G. W69-08349

PROTECTING WATER AND ICE SOURCES. For primary bibliographic entry see Field 05G. W69-08350

PROTECTING WATER AND ICE SOURCES. For primary bibliographic entry see Field 05G. W69-08351

ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND NAVIGATION For primary bibliographic entry see Field 04A. W69-08352

CLASSIFICATION OF WATERS AND STAN-DARDS OF PURITY.

For primary bibliographic entry see Field 05F W69-08353

FLOWAGE. For primary bibliographic entry see Field 04A. W69-08354

GOLDIN V TRUSTEES OF VILLAGE OF EL-LENVILLE (INTERFERENCE WITH WATER

SUPPLY BY CITY). For primary bibliographic entry see Field 04C. W69-08355

DELAWARE RIVER AND BAY AUTHORITY.

Del Code Ann tit 17, sec 1801-1808 (Supp 1966).

Descriptors: *Delaware, *New Jersey, *Bridges, *Interstate compacts, Federal government, State governments, Interstate commissions, Bridge construction, Construction costs, Legislation, Financial analysis, Maintenance, Management, Administrative agencies

Identifiers: *Delaware Memorial Bridge, Tolls, Toll bridges, Interstate bridges, Bond financing, Bridge management, Delaware-New Jersey Compact.

The Delaware River and Bay Authority shall be the agent for Delaware and New Jersey in connection with the construction, maintenance and control of the Delaware Memorial Bridge. The authority shall succeed to all rights and duties formerly vested in the Delaware Interstate Highway Division in so far as they pertain to the bridge. The authority's control shall be subject to the rights of holders of outstanding Delaware Memorial Bridge Revenue Bonds of the state of Delaware. The authority shall arrange with the Interstate Highway Division for an audit and for fixing a date upon which the books of the Division shall be closed and from which the authority shall take over control of the bridge. This chapter shall take effect upon completion of the chapter shall take effect upon completion of the last of the following three events: (1) when the Delaware-New Jersey Compact becomes binding on this state; (2) when New Jersey enacts legislation having a substantial identical effect with this chapter; and (3) when the US Congress enacts an amendment to 60 stat 533 eliminating the requirement that the bridge become tell free upon the control of the control o ment that the bridge become toll free upon payment of the outstanding bonds. W69-08356

DAMS AND FLOWAGE: PROCEEDINGS IN COURT.

For primary bibliographic entry see Field 04A. W69-08357

POLLUTION CONTROL AUTHORITY SOUTH CAROLINA.

For primary bibliographic entry see Field 05G. W69-08358

SOUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING COMMIT-

SC Code Ann secs 70-21 thru 70-25 (Supp 1968).

Descriptors: *South Carolina, *Water resources development, *Water quality control, *Water management (Applied), Water utilization, Industrial water, Municipal water, Administrative agencies, Research and development, Legislation, State governments, Hydroelectric power, Navigation, Flood control, Drainage, Watershed management, Wildlife management, Water supply.

The South Carolina Water Resources Committee with 18 members appointed by the Governor is created. The interests represented are agriculture, industry, municipalities and salt water interests. Eight other members shall be the heads of the Department of Agriculture, Pollution Control Authority, Wildlife Resources Commission, State Forestry Commission, Soil and Water Conservation Committee, State Development Board, Clemson University Water Resources Research Institute, and the State Highway Department. The committee is authorized to conduct studies for the purpose of making recommendations to the Governor and to the General Assembly regarding a comprehensive water resources policy for the state. The committee may review actions of state agencies and federal projects in regard to water resources with a view toward establishing a consistent water resources policy. The committee, in exercising its duties, shall consider the need for: adequate supplies of water for domestic, industrial, agricultural and municipal uses; water quality controls; navigaand multicipal uses, water quality controls, naviga-tion facilities; hydroelectric power; flood control; land stabilization; drainage; watershed manage-ment; and wildlife management. (Kahle-Fla) W69-08359

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

REGULATION OF WATER RESOURCES. For primary bibliographic entry see Field 04A. W69-08360

DAMS IN DISREPAIR AND CHANNEL IM-PROVEMENT.

For primary bibliographic entry see Field 04A

FENCING WATER-WAYS. NH Rev Stat Ann sec 475:1-475:3 (1968).

Descriptors: *New Hampshire, *Canals, *Safety, *Cities, Ditches, Streams, Legislation, Regulation, Local governments, Municipal water, Safety fac-

Identifiers: *Fences.

The elected officials of any town or city may require the owner or user of any canal or waterway within the city or town, deemed by them to be dangerous to travelers or children, to fence the same. Upon failure of the owner to fence the canal within 60 days after written notice, the officials shall have the canal fenced, and collect the expenses from the owner or user in an action of assumpsit. (Kahle-W69-08362

LEGAL FENCES; WATERS, WHEN NOT SUF-FICIENT FENCE.

NH Rev Stat Ann sec 473:5, 473:7 (1968).

Descriptors: *New Hampshire, *Boundaries (Property), *Boundary disputes, *Rivers, Ditches, Streams, Legislation, Regulation, Adjudication procedure, Construction, Legal aspects. Identifiers: *Fences, *Fence viewers.

All fences in good repair and of such height as to be reasonably adequate for their purpose and all rivers, ponds, creeks, ditches and hedges deemed by the fence viewers as equivalent thereto, shall be termed legal and sufficient fences. The fence viewers, upon application of either party, shall view any river, pond, creek, or ditch alleged not to be a sufficient fence. If they determine that it is not sufficient, they shall make a division of the fence. If it is unreasonable to build a fence on the boundary line they shall determine where it shall be built and give notice to the parties to build it according to the division and location. (Kahle-Fla)

FISH CONSERVATION RULES AND REGULA-TIONS,

Vt Stat Ann tit 10, secs 4601-4611 (Supp 1968).

Descriptors: *Vermont, *Conservation, *Fish conservation, Fish management, Fish stocking, Wildlife, Sturgeon, Pikes, Trout, Sport fish, Fisheries, Water conservation, Streams, Fish farming, Fish hatcheries, Legislation, Fish, Regulation, Administrative agencies, Water policy, Water sports, Recreation, Sport fishing, Legal aspects, Ice fish-

Identifiers: Pickerel.

No person shall take or possess fish in violation of regulations relating thereto. Fish taken unintentionally but illegally shall immediately be released. Ice fishing, is allowed only by board regulation. Pickerel or great northern pike shall not be introduced into any waters or any other fish in-troduced into any waters without first obtaining permission to do so. No fish shall be taken by (1) explosives; (2) drug or poison; (3) shutting or drawing off water; (4) illegal nets, set lines, fishing otter, trawl, jack light, electrical or other such device. Unless authorized, no person shall obstruct a natural or artificial stream. Except as authorized and regulated by the Commissioner of Conserva-tion, no one shall fish for sturgeon. Importation of dead trout for sale shall be subject to regulation by

the Commissioner. No person shall buy or sell a salmon, trout or black bass taken in this state or imported from a place where such sale is prohibited except when such fish is reared in licensed propagation farms. (Helwig-Fla) W69-08364

ROAD CONSTRUCTION.

For primary bibliographic entry see Field 04C. W69-08365

POLILITION. POISONING. ETC.. STREAMS; DYNAMITING.

For primary bibliographic entry see Field 05G W69-08366

KOSTON V TOWN OF NEWBURGH (WATER DISTRICT ASSESSMENT).

299 NYS2d 1007-1009, 1969.

Descriptors: *New York, *Water districts, *Assessments, *Municipal water, Cities, Wells, Judicial decisions, Legal aspects, Water law, Land tenure, Public rights, Public benefits, Taxes.

Petitioner, a landowner having his own private well, was located in a certain water district. He was assessed for the water district benefits, as were all persons owning real property in the water district. Petitioner paid the assessment under protest contending that he derived no benefit from the water district since he had his own water supply. The court held that even though a property owner has made private arrangements to provide the service offered by a special improvement district, he may be assessed on a benefit basis for the service of fered in the district. The test of whether land has been benefited is not whether any advantage on its owner has been received but whether its general value has been enhanced. Here since fire protection facilities were improved and property values enhanced, benefits had accrued and the assessment was proper. (Carruthers-Fla) W69-08367

ANNUTTO V VILLAGE OF HERKIMER (MU-NICIPAL LIABILITY FOR BLASTING CAUSING FLOOD DAMAGE). 297 NYS2d 295-296 (NY App Div 1968).

Descriptors: *New York, *Ice, *Obstruction to flow, *Ice breakup, Judicial decisions, Water law, Ice jams, Cities, Damages, Watercourses (Legal), Explosives, Flow, Flow around objects, Flow rates, Legal aspects, Local governments, Public benefits, Bridges, Flooding, Floodwater, Flood damage. Identifiers: *Blasting, *Negligence, Strict liability.

A lower court found the Village of Herkimer, liable for flood damage caused to plaintiff as a result of the blasting of an ice jam which obstructed a local waterway. Strict liability was the basis for recovery. On appeal plaintiff's judgment was reversed. The court held that the blasting was done to secure the public safety and that before plaintiff could recover for damages caused by floodwater stemming from defendant's action, a case in negligence would have to be established. (Holt-Fla) W69-08368

PUBLIC SERVICE COMPANIES.

SC Code Ann secs 58-651, 58-691 thru 58-702 (1962).

Descriptors: *South Carolina, *Railroads, *Canals, *Public utilities, Ships, Transportation, Canal construction, Public benefits, Navigation, Navigable waters, Legislation, Regulation, State jurisdiction, State governments, Leases, Condemnation, Dams, Reservoirs, Docks, Locks. Identifiers: Canal corporations, Steamship lines,

Public service companies.

Three or more persons desiring to form a railroad corporation, canal corporation, or steamboat corporation may do so by petition to the Secretary of State setting forth: their names and addresses; the name of the corporation; its principal place of business; the general nature of its business; the termini and routes of the railroad, canal or steamboat line as well as towns and cities it will pass through; and a minimum amount of capital stock to be issued. Canal companies shall have all the powers of electric light and power companies and may build, maintain and lease canals, locks, dams, reservoirs and wharves. Necessary land may be acquired by purchase or condemnation when the canal is to kept open for public navigation. Canal companies may mortgage their property and issue bonds. The state may acquire property of a canal company upon payment of just compensation. No rights of the state in canals shall be transferred except by act of the General Assembly. Nothing herein shall prevent landowners from recovering just compensation for injury to property rights. Steamship companies may exact tolls for use of their wharves or landings. Steamship lines between Savannah, Georgia, and Bluffton, South Carolina, may not change their schedule except upon ten days notice. (Kahle W69-08369

SOIL CONSERVATION AND IMPROVEMENT. For primary bibliographic entry see Field 04D. W69-08370

MINES AND MINERALS.

SC Code Ann secs 1-361, 1-363, 1-364, 1-365, 1-367, 1-372, 1-376, 1-377, 1-379 thru 1-381 (1962) as amended (Supp 1968).

Descriptors: *South Carolina, *Phosphates, *Mining, *State jurisdiction, Navigable waters, Streams, Marshes, Land use, Permits, Leases, Rates, Royalties, Legislation, Administrative agencies, Regulation, Contracts, Ships, Boats, Dredging. Identifiers: Penalties.

The Public Service Authority may lease mineral rights, excluding phosphate, upon land owned by the authority. The State Budget and Control Board may lease state lands and waters under its control. Such leases shall be subject to laws enacted for the conservation of mineral resources. The State Budget and Control Board shall have the responsibility of protecting state interests in phosphate rocks and phosphatic deposits in navigable streams and marshes. The Board may take such action necessary to protect such interests in territory claimed by other parties. The Board may grant leases to mine phosphate in state waters for such terms as may be determined by the Board. The Board may make a firm contract for royalty to be paid to the state. The Board is vested with control over all phosphate mining in state territory and may fix and alter the royalty to be paid to the state. A fine of \$10 per ton is imposed for mining phosphate without a state license. It is unlawful to purchase phosphate from one not duly authorized to mine such phosphate. Any unauthorized vessels or dredges used to mine phosphate are declared forfeited to the state. Mining without a license or interfering with the Board, or anyone authorized by the Board, is punishable by fine between \$100 and \$500 and/or imprisonment not less than one year. (Kahle-Fla) W69-08371

INTERFERENCE WITH NAVIGATION, ETC. For primary bibliographic entry see Field 04A. W69-08372

MISCELLANEOUS PROVISIONS (UNLAWFUL DISCHARGE OF OIL IN CHARLESTON HAR-BOR).

For primary bibliographic entry see Field 05G. W69-08373

Ecologic Impact of Water Development—Group 6G

GARRISON FURNITURE CO. V SOUTHERN ENTERPRISES, INC. (AVULSION).

436 SW 2d 278-282 (Ark 1969).

Descriptors: *Arkansas, *Riparian rights, *Accre-Lescriptors: "Arkansas, "Riparian rights, "Accretion (Legal aspects), "Riparian land, Land tenure, Land use, Land forming, Land reclamation, Islands, Watercourses (Legal), Judicial decisions, Legal aspects, Water law, Avulsion, Rivers, Boundary dignutes. dary disputes.

Identifiers: Adverse possession.

Plaintiffs brought suit to quiet title to 91 acres of riparian land on the Arkansas River. Defendant claimed title by adverse possession and by a chain of conveyances beginning in 1920. The chancellor found that defendant had acquired the entire 91 acres by adverse possession for more than 7 years under color of title. Plaintiffs claim title to the property as a natural accretion to their lands resulting from a gradual shifting back and forth of the channel of the river. The appellate court defined the issue to be whether the property came into being as an island or as an accretion to the mainland and found the land to be an accretion. The court, in reversing the chancellor, held that plaintiffs have had constructive possession of all their land not actually occupied adversely by defendant or his predecessors in title. Hence, defendant's claim would be confined to that part of the riparian tract shown to have been adversely occupied for 7 or more successive years. (Carruthers-Fla) W69-08374

STATE EX REL TETER V STATE ROAD COMMISSION (DAMAGE ASCERTAINMENT). For primary bibliographic entry see Field 04C W69-08375

SUPPLY WATER NORTH AMERICAN WATER PROBLEMS AND THEIR SOLUTION, American Bar Association, Chicago, Ill. For primary bibliographic entry see Field 06B. W69-08380

A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER,

For primary bibliographic entry see Field 06B. W69-08487

SUSQUEHANNA FLATS.

Md Ann Code Art 66C secs 165, 171, 173A

Descriptors: *Maryland, *Hunting, *Waterfowl, *Riparian rights, Legislation, Regulation, Water wildlife, Fishing, Management, Water rights, Preferences (Water rights), Competing uses, Riparian land, Riparian waters, Wildlife conserva-

Identifiers: Chesapeake Bay.

There are certain special regulations relating to hunting for that part of the Chesapeake Bay known as Susquehana Flats. Any owner of land bordering this area may, during October of each year, select and mark any point on his shore for the purpose of hunting and, immediately following such selection, he will have exclusive rights to hunt within onequarter mile of the point so marked. Fishing with hook and line in certain areas is prohibited during the regular duckling season, except that fishing is allowed on Sundays during this period. (Johnson-Fla) W69-08492

KINGERY V REEVES (EASEMENT FOR IR-RIGATION CANAL).

113 So 2d 64-67 (La Ct App 1959).

Descriptors: *Louisiana, *Irrigation canals, *Canal construction, *Right-of-way, Easements, Irrigation, Judicial decisions, Boundary disputes, Water wells, Water rights, Water utilization, Alteration of flow, Relative rights, Land use.

This was a slander of title action to compel cancellation of a right-of-way granted by plaintiff landowner for canal purposes to defendant's predecessor. In consideration for the right-of-way defendant's predecessor was to construct a canal from which plaintiff had the right to draw water for irrigation. The deed provided for automatic termina-tion of the right-of-way if not used for canal purposes for three consecutive years. Plaintiff contends the right-of-way terminated because in 1945 defendant's predecessor abandoned operation of the canal system insofar as plaintiff's land to the north was concerned and that defendant's use of the canal for his own private purposes was not such a use as to prevent termination. The court held that defendant's predecessor had the express right to convey the right-of-way to defendant and that there was no restriction that the canal be used to carry water from any specified source or be used only in conjunction with the entire canal system. Although plaintiff, having constructed an irrigation well, no longer used the canal for irrigation the deed reflected no intention that the right-of-way should cease when he no longer benefitted. Judgment was for defendant. (Kahle-Fla) W69-08538

STATE V BENTLEY (WATER DAMAGE). 71 NW 2d 780-787 (Minn 1955).

*Minnesota, *Eminent domain. Descriptors: *Water control, *Projects, Project planning, Water policy Project purposes, Competing uses, Project policy, Project purposes, Competing uses, benefits, Public rights, Condemnation, Condemnation value, Judicial decisions, Legal aspects, Water distribution (Applied), Water law, Water resources, Compensation, Flow augmentation, Channel improvement, Damages.

Plaintiff landowners intervened in condemnation proceedings instituted pursuant to Minnesota statutes which authorized water control projects. Plaintiffs claimed that their lands had been damaged by an increased volume of water flowage created by the water control projects. Plaintiffs' petition was denied by the district court and an appeal was taken to the Minnesota Supreme Court. The water control projects involved here consisted of widening and deepening existing channels and constructing dams and dikes on certain lakes. The supreme court held that the water control projects did no more damage to plaintiffs' lands than would have occurred in the same manner in a state of nature and that plaintiffs' lands had not been taken, damaged or destroyed by the state of Minnesota so as to justify compensation in an eminent domain proceeding. (Carruthers-Fla)

BOROUGH OF WINDBER V SPADAFORA (CONSTRUCTION EXTENDING INTO NON-NAVIGABLE WATER).
356 Pa 130, 51 A2d 726-730 (1947).

*Non-navigable *Pennsylvania, Descriptors: waters, *Riparian rights, *Streamflow, Damages, waters, "Riparian rights, "Streamflow, Damages, Local government, Cities, Legislation, Alteration of flow, Obstruction to flow, Floods, Riparian waters, Downstream, Administrative agencies, Streambeds, Legal aspects, Permits, Relative rights, Repairing. Identifiers: Injunctions (Mandatory), Injunctions

(Prohibitory).

Defendant owned riparian land on a stream within plaintiff borough. She erected a building on her lot and projected the foundation wall into the stream and projected the foundation wall into the stream without a permit, as required, from the Water and Power Resources Board. The structure had been partially washed away and defendant expressed her intent to repair it despite being refused a permit by the Board. Plaintiff alleged the structure narrowed the stream causing downstream flood damage and asked an injunction to restrain the rebuilding of the structure and to require the removal of the encroaching portion. The Board joined as an intervener. The court held that a riparian owner on a non-navigable stream may construct anything he pleases to the thread of the stream unless it injures the public. The borough could not complain except to the extent the public rights were affected. The injunction to require removal of the structure was denied because of the borough's failure to prove injury to the public and because of the borough's long delay in seeking the injunction. The injunction, prohibited defendant from repairing her wall until a permit was issued; however, the injunction was granted because of the statutory requirement to obtain a permit. (Helwig-Fla) W69-08567

UNITED STATES V LOUISIANA (SUIT BY FEDERAL GOVERNMENT AGAINST STATE TO DETERMINE CONTROL OF AREA OUT-SIDE 3 MILE BELT).

339 US 699-706 (1950).

Descriptors: *Louisiana, *Federal jurisdiction, *Ownership of beds, *Federal-state water rights conflicts, State jurisdiction, Low water mark, Shores, Oceans, Gulf of Mexico, Beds under water, disputes, Minerology, Legal aspects, Judicial decisions, Treaties, United States.

Identifiers: *Three mile belt, Injunction.

The federal government alleged that all lands, minerals, and other things lying seaward of the ordinary low water mark on the coast of Louisiana and outside the inland waters were in the full domain and power of the United States government. They sought a decree adjudging and declar-ing the rights of the federal government in this area as against Louisiana, enjoining all others against trespass. Louisiana alleged that the federal govern-ment had claim to only those beds of the Gulf of Mexico to the extent of powers existing under the constitution, laws and treaties of the United States, none of which would affect the area herein concerned. Basing their decision on United States v California, 332 US 19, which held that the three mile belt of the shore was in the domain of the United States rather than the separate states, the Supreme Court reasoned that it would follow a fortiori that the area claimed by Louisiana extending 24 miles seaward beyond the three mile limit was also within the domain of the United States rather than that of Louisiana. (Logan-Fla) W69-08597

6G. Ecologic Impact of Water Development

AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIVER, Mississippi State Univ., State College. Dept. of Wil-

dlife Management.
Dale H. Arner, Warren G. Anding, William

Dale H. Arner, Warren U. Andring, William Lunceford, and Charles Summerour. Completion Report, Mississippi State Water Resources Research Institute, June, 1969. 48 p. OWRR Project A-029-MISS.

Descriptors: *Ecology, *Recreation, Invertebrates. Identifiers: Luxapalila River (Miss).

An ecological and recreational use survey was made of the Luxapalila River in Mississippi. This study was made before channelization work was started by the Army Corps of Engineers. A followup ecological study is planned after channelization work is completed. Four stations located along a 10.5 mile stretch of river were selected for making certain chemical and biological measurements. The study was started in July, 1968, and concluded in June, 1969. Results of this study revealed that the

Group 6G—Ecologic Impact of Water Development

Luxapalila River is rich in species of fish with 37 different species recorded. Collections of invertebrates were made over a period of 12 months by sweep netting and with square foot bottom samplers. The largest standing crop of 1.93 lbs. per acre (oven dry weight) was collected in September, and the smallest standing crop, 0.01 lbs. per acre, was found in December. Water chemistry and both air and water temperatures were recorded. The information obtained was characteristic of that from similar streams. Water table levels were measured at selected distances adjacent to the river. A survey of recreational use of the river was made, and it revealed that fishing was the major use (59 percent), FOLLOWED BY SWIMMING (28 percent). Ninety-five percent of the recreational parties interviewed were residents of the area, and most (83 percent) of these parties traveled less than 16 miles round trip to visit the river. Inaccessibility to the river due to private land holdings is believed to be a major factor in the small recreational use made of this river. W69-08399

07. RESOURCES DATA

7A. Network Design

THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON NETS OF VARIOUS ORDERS,

Illinois Univ., Urbana; and Illinois Univ., Cham-

paign. K. H. Liao, and A. E. Scheidegger. Water Resources Res, Vol 5, No 3, pp 744-746, June 1969. 3 p, 1 tab, 9 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, Drainage density, Tributaries, Drainage systems, Geomorphology, Networks. Identifiers: Strahler stream orders, Horton stream

Tables of expected stream lengths and drainage areas of Strahler streams are presented for various orders for networks with various numbers of firstorder streams. The values are based on a randomgraph stream-network model. (Knapp-USGS) W69-08211

THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESEARCH AND ITS CON-SEQUENCES,

Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center. D. L. Chery, Jr.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 198-202, 1968. 5 p,

Descriptors: *Hydrologic data, *Data processing, *Digital computers, Data storage and retrieval, Data collections, Data transmission, Instrumentation, Telemetry, Remote sensing, Research and development, Hydrology. Identifiers: Data analysis

The digital computer is now an indispensable tool in the processing of hydrologic data. Further, it has become an indispensable assistance in the analysis of collected data and information. The ultimate consequence of this assistance will be the direct interfacing of computers with the experiment, Immediate consequences of the presence of computers are the need to reduce to digital form great masses of accumulated records; the reconsideration of experimental designs; the development of improved instrumentation and data acquisition systems; and the adjustment in thinking to realize the potential of computer assistance. (Knapp-USGS) W69-08233

WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., Geological Survey, Tucson, Ariz. Water Resources

For primary bibliographic entry see Field 02F. W69-08299

HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN,

Food and Agriculture Organization of the United Nations. Chad Basin Commission. E. Gischler

Nature and Resourc, Vol 3, No 3, pp 9-15, 1967. 7

Descriptors: *Synthesis, *Hydrologic data, Lake basins, Geomorphology, Arid lands, Maps, Hydrog-raphy, Large watersheds, Groundwater, River basins, Electric analog models, Aquifers, Salinity, Hydrogeology, Hydrological aspects, Administrative agencies, Coordination, Project purposes, United Nations, Water resources development, Radioisotopes, Stable isotopes.

Identifiers: Cameroon Republic, *Lake Chad Basin, Unesco, Chad Republic, Federation of Nigeria, Niger Republic.

This paper reports on studies and projects important to the Unesco hydrological synthesis of information on the Lake Chad basin, and on activities of the Unesco team. A short history is presented of the development of international cooperation in this four nation basin; Chad Republic, Federation of Nigeria, Niger Republic, Cameroon Republic. A review of the important research activities and publications concerning cartography, geology, pedology and hydrology of each country shows them to have been abundant and often very complete. The coordinating program of Unesco has as objectives: (1) acting as intermediary between governmental and scientific institutions, (2) coordination of present and future activities, (3) correlation of existing reports and maps, and (4) arbitration of criteria of the synthesis for utilization in formulating an analogue model. Present programs reported on include phreatic water studies in Nigeria and stable and unstable isotope investigations. (Sherbrooke-Ariz) W69-08304

AN APPLICATION OF MULTIVARIATE ANAL-YSIS TO SEDIMENT NETWORK DESIGN,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James R. Wallis, and Henry W. Anderson. Int Ass of Sci Hydrology, No 67 (1965): 357-378.

Descriptors: *Analytical methods, *Sediment yield, *Hydrologic data, Project planning, Sampling, Regression analysis, Environmental effects, California.

Identifiers: Principal components analysis, Network design.

Most stream sedimentation stations are selected to answer the simple question, 'What sedimentation problem would confront a structure installed at this site today.' A network of sedimentation stations resulting from repeated application of this criterion will almost certainly be unsatisfactory for answering problems in sedimentation research and may often be unsatisfactory for answering the simple needs for structural design and evaluation. Analysis of the existing northern California suspended sediment data suggests that for some stations the number of sediment samples taken could be greatly reduced without impairing the accuracy of pre-dicted sediment yield, and that in addition samples need to be taken on other watersheds. Network design should be kept flexible so as to meet changing sediment discharges from watersheds. An 11step procedure is given which could be used for designing a sediment network to yield the maximum of useful information. An equation relating sediment discharge to changing watershed varia-bles of forest fires, unimproved roads, logging of forests and conversion of forests to grasslands was developed by regressing on principal components.

W69-08497

RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE NETWORKS,

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02E.

W69-08571

SYSTEMATIC VARIATION PATTERN OF AN-NUAL RIVER FLOWS,

Melbourne Univ., Parkville (Australia). Dept. of Engineering; and Scott and Furphy, Melbourne (Australia)

For primary bibliographic entry see Field 02E. W69-08591

HYDROLOGIC DATA SYSTEMS--DEVELOP-ING CONCEPTS,

Geological Survey, Washington, D. C.

E. L. Hendricks.

Proc 41st Annu Conv Western State Eng, Sept 10-13, 1968, Jackson Lake, Wyo, p 64-66, 1969. 3 p.

Descriptors: *Data collections, *Hydrologic data, Networks, Governments, State governments, Data storage and retrieval, Data processing. Identifiers: U S Geological Survey, Water-data acquisition.

Water-related activities in the United States include hydrologic-data collection, planning, engineering, construction, water allocation and administration, etc. At thousands of points decisions are made which involve the use of water data. Certain water-data elements are the common constituents for the inputs to many of these decision points-that is, water data in general are subject to multiple uses. The water-data activity of the Geological Survey was founded on the principle-probably never precisely enunciated--that, in the public interest, the water-data base common to so many uses should be collected by one agency nationally oriented and capable of maintaining uniform and acceptable standards of accuracy throughout the Nation. The Bureau of the Budget Circular No. A-67, which provides for the coordination of water-data acquisition activities of the Federal agencies, starts from an assumption that a single agency not only should coordinate these activities but also should design the 'National Network' and be largely responsible for implementa-tion of that part of the optimum data-acquisition program which constitutes the common data base required by several agencies. The Department of the Interior enunciated a similar thesis wherein the Geological Survey should provide the basic waterdata needs for the entire Department. (USGS)

7B. Data Acquisition

A SIMPLE SNOWMELT LYSIMETER,

Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station For primary bibliographic entry see Field 02C. W69-08206

COMPARISON BETWEEN RAIN GAGE AND LYSIMETER MEASUREMENTS. California Univ., Davis. Dept. of Water Science

and Engineering.
For primary bibliographic entry see Field 02B.
W69-08208

TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH ACID KAOLINITIC SOIL,

Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab. For primary bibliographic entry see Field 02F

W69-08286

THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,

Zagreb Univ. (Yugoslavia). Geophysical Inst.

Zvonimir Krulc, and Milovan Mladenovic. Internatl Assoc Hydrogeol, Congress of Istanbul, 1967, Memoir 8, pp 441-449, 1968. 9 p, 8 fig, 36 ref.

Descriptors: *Aquifer characteristics, *Arid lands, Deserts, Depth, Hydrology, Surface water, Semiarid climates, Saline water.

Identifiers: *Geoelectrical profile, *Geoelectrical sounding, Egypt, Libya.

The intention of this paper is to indicate the possibilities and limitations of geoelectrical methods in ground-water exploration of unconsolidated formations in arid or semi-arid regions (Egypt, Libya), particularly where great areas are covered by widespread superficial deposits. By use of resistivity techniques -- geoelectrical sounding and profiling -- it is possible to solve problems on the penetration of saline water into the dry land, the separation of fresh lenses floating on saline water, the determination of the thickness of alluvial deposit, and the establishment of the depth of water-impermeable basement. By the geoelectrical sounding method, a hydrogeological cross section is obtained at measureing points as well as the data concerning the depth of single horizons in underground. In this way the vertical geoelectrical sounding replaces exploration drilling to a certain degree. (Sherbrooke-Ariz) W69-08297

DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,

Economic Research Service, Washington, D.C. Resource Data Systems Group. For primary bibliographic entry see Field 10. W69-08389

A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO,

Wisconsin Univ., Milwaukee.

Melvin L. Fowler.

Archaeology, Vol 22, No 3, p 208-215, June 1969. 8 p, illust.

Descriptors: *Distribution systems, *Soil profiles, *Conveyance structures, Soil structure, Irrigation canals, Water supply, Aerial photography. Identifiers: *Mexico, *History of technology, Archaeology.

A field investigation, based upon aerial photointerpretation, was made of an archaeological zone just east of the city of Puebla, state of Puebla, Mexico. This zone consists of two hills on a gently sloping plain with groups of pyramids or mounds on both the plain and one of the hills. Ground reconnaissance revealed man-made disturbance of the soil along a straight line alignment first identified in the aerial photographs. Stratigraphic cuts were made in the disturbed areas in three meter square units for an area of thirty by three meters. These test squares were expanded to form a thirty meter long trench. Two soil profiles of this area are illustrated. Schematic cross-secions show the probable sequence of channel changes in the system caused by erosion and sedimentation which occurred during use. Probable use of the system for water supply or irrigation purposes is discussed. From radiocarbon dating of organic materials in a nearby mound, which had ceramics similar to those found in a age of the system is estimated to be earlier than 200 B C mound constructed over a part of the system, the W69-08396

A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES,

Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station. G. J. Gottfried, and C. J. Campbell. USDA Forest Serv Res Note RM-120, (1968). 3 p.

Descriptors: *Instrumentation, *Snowpacks, *Temperature, Thermocline. Identifiers: *Thermistor, *Snowpack temperature.

A phenol-resin-based shield has been developed to protect a thermistor probe that can be inserted into a snowpack. With the probe and wheatstone bridge circuit temperatures can be measured within the snowpack to 0.1 degree C. W69-08469

STREAMFLOW VOLUMES AND HYDRO-GRAPHS BY FLUORESCENT DYES,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. B. C. Goodell, J. P. C. Watt, and T. M. Zorich. Int Un of Forestry Res Organizations, 14th IUFRO Congress, 1967, (v. 1, Sect. 11): 325-348.

Descriptors: *Stream gages, Gaging stations, Hydrographs, Hydrometry, Tracers, Instrumentation, Fluorescence, Flow rates, Flow measurement, Flow, Fluorometry, Identifiers: Stream flow gaging.

Two new methods of streamflow gaging are under development. Each employs the principle of dilution of fluorescent dye Rodamine WT. In each, a concentrated dye solution is injected at a constant low rate into stream from a Mariotte vessel of refined design. In one, small, discrete samples of the dosed stream are accumulated in a storage vessel. Sampling is at a stream point where mixing is complete and accomplished by a simple siphon device operating at a constant time cycle. Fluorometric analysis of a sample from the storage vessel following a week's accumulation enables calculation of weekly average rate of streamflow with useful accuracy if discharge fluctuations during week are moderate. In the other method, a small continuous diversion from the dosed stream is brought into contact with a clock-driven strip of commercially available gelatin-coated film. Dye is sorbed by the gelatin proportionately to its concentration. Laboratory analysis of the film by a specially modified fluorometer yields a hydrograph of the stream. This method is not limited to moderately fluctuating streams. Both methods are particularly designed for use on mountain streams where access is difficult and many years of record unnecessary. Development is continuing. W69-08480

USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED MANAGEMENT, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James L. Smith.

Trans American Nuclear Society 10 (1): 78, 1601, 1967. 1 p.

Descriptors: *Snow, *Density stratification, Watershed management, Snowmelt, Snow management, Hydrologic aspects.
Identifiers: *Snow density, *Density profiles,

*Snow hydrology.

Snow density profiles taken under natural snowmelt and under the impact of rain falling on snow show some current snow hydrology concepts to be inaccurate. W69-08496

MULTIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON USING DATA OF KNOWN FUNCTIONAL RELATIONSHIP, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James R. Wallis.

Water Resources Research, Vol 1, No 4 (1965): 447-461

Descriptors: *Estimating equations, *Forecasting, *Analytical methods, *Regression analysis, Statistical models, Mathematical models, Mathematical studies, Hydrologic aspects.

Identifiers: Factor analysis, Principal components analysis, Key cluster analysis, Multivariate analysis.

Conventionally hydrologists have used regression analysis for solving their multivariate problems. Recently other multivariate statistical methods have been advocated. This paper discusses and compares the effectiveness of six methods of analysis: regression, principal component, varimax, oblimax, key cluster, and object. Strengths and weaknesses of each method are discussed and the combination of principal component regression with varimax rotation of the factor weight matrix is recommended for an initial analysis of multifactor hydrologic problems. W69-08499

WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTEN-TIAL OF UNIT AREAS

TIAL OF UNIT AREAS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02A.
W69-08504

GENERAL REPORT SYMPOSIUM SUBJECT: NEW IDEAS AND SCIENTIFIC METHODS IN STOCHASTIC (STATISTICAL) HYDROLOGY, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

Henry W. Anderson.
Int Hydrol Symp Proc (1967): 322-335, Colorado State University, Fort Collins, Colo.

Descriptors: *Reviews, *Statistical methods, Regression analysis, Frequency analysis, Mathematical models, Mathematical studies, Hydrologic aspects.

Identifiers: Multivariate analysis, Baysian Theory, Principal components, Gamma distributions.

Summarizes, critically reviews and expands on the contents of eight papers on stochastic (statistical) hydrology. Subjects included were Baysian Theory, multivariate analysis, gamma distributions, and applications of the theory of runs. W69-08505

WHEN IS IT SAFE TO EXTEND A PREDICTION EQUATION-AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS,

Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. James R. Wallis.

Water Resources Research, Vol 3, No 2, (1967): 375-384.

Descriptors: *Statistical methods, *Forecasting, *Regression analysis, Environmental effects, Sediment yield, Sedimentary petrology. Identifiers: *Principal components analysis, Linear discriminant functions, Watershed variables.

Prediction equations for hydrologic events developed from one population of observations (watersheds) are often solved for another population that is removed either in time or in space. Predictions of this kind are never certainties, although some predictions are obviously more uncertain than others. This paper proposes an empirical uncertainty classification that may be found useful for separating probably successful from probably unsuccessful extensions of prediction equations. The classification system is illustrated by a prediction equation for suspended sediment discharge developed from some watersheds in California, and by a discriminant function for marine versus nonmarine sediments based upon microelements.

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

DETERMINATION OF FEEDING CHRONOLO-GY IN FISHES,

Marquette Univ., Milwaukee, Wis. Dept of Biolo-

For primary bibliographic entry see Field 05C. W69-08514

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS,
Corps of Engineers, Sacramento, Calif. Hydrologic

Engineering Center. For primary bibliographic entry see Field 06B.

W69-08543

DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRA-TION.

Dohrmann Instruments Co., Mountain View, Calif. For primary bibliographic entry see Field 05A. W69-08559

AN INEXPENSIVE RECORDING SETTLING TUBE FOR ANALYSIS OF SANDS, University of Southern California, Los Angeles.

J Sediment Petrol, Vol 39, No 2, pp 777-780, June 1969. 4 p, 4 fig, 1 tab. USGS Contract No 14-08-0001-10862.

Descriptors: *Particle size, *Settling velocity, *Instrumentation, Sieve analysis, Deposition (Sediments), Analytical techniques, Laboratory tests, Calibrations

Identifiers: Settling tube, Particle size analysis

An automatically recording settling tube for rapid size analysis of sand can be constructed from Plexiglas tubing, a transducing cell, and a small chart recorder for less than \$1100 (1968 prices). It recorder for less than \$1100 (1968 prices). It eliminates time consuming processes associated with sieving, and yields data in terms of hydraulic equivalent size. Reproducibility of the arithmetic mean averages 0.09% for several replicate samples. This compares with 1.0% for sieves, and 5% for the Emery Tube. (Knapp-USGS) W69-08582

CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY

RECORDING SETTLING TUBE, University of Southern California, Los Angeles. Dept. of Biology.

David O. Cook

analysis.

J Sediment Petrol, Vol 39, No 2, pp 781-786, June 1969. 6 p, 5 fig, 2 tab, 9 ref. USGS Contract 14-08-0001-10862.

Descriptors: *Particle size, *Settling velocity, *Instrumentation, *Calibrations, Sieve Analytical techniques, Laboratory tests. analysis, Identifiers: Settling tube calibration, Particle size

Calibration of the automatically recording settling tube at the University of Southern California is done by using small groups of glass beads. The set tling times are adjusted to a specific gravity of 2.65 and the calibration extrapolated for different temperatures. The calibration does not compensate for interaction among settling grains, but this factor may significantly influence the deposition of aqueous sands. The range of calibration and laboratory error for the settling tube is small compared to the textural variation of natural sands. (Knapp-USGS) W69-08583

A CONTACT GAGE FOR RAPID AND ACCU-RAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTI-CLES.

Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics; and National Iranian Oil

Co., New York.
Hassan G. Modarresi.
J Sediment Petrol, Vol 39, No 2, pp 793-797, June 1969. 5 p, 2 fig, 11 ref.

Descriptors: *Particle shape, *Particle size, *Measurement, *Instrumentation, Sedimentology, Laboratory tests, Evaluation, Dimensions, Test procedures

Identifiers: Particle shape analysis, C-axis length (Grains).

Previous methods for evaluating the c-axis (shortest dimension) of sand-sized particles have proven impractical and have not been widely utilized. This paper describes a new method which permits rapid and accurate c-axis measurement of numbers of sand grains. With this technique, sand samples can be simply and efficiently sorted according to c-axis values. (Knapp-USGS) W69-08584

A RAPID METHOD FOR THE DETERMINA-TION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL FRAGMENTS.

Ibadan Univ. (Nigeria). Dept. of Geology

Kevin Burke, and S. J. Freeth.

J Sediment Petrol, Vol 39, No 2, pp 797-798, June 1969. 2 p, 3 fig, 2 ref.

Descriptors: *Gravels, *Particle shape, *Particle size, *Instrumentation, *Measurement, Sedimentology, Laboratory tests, Estimating, Dimensions,

Identifiers: Overhead transparency projectors.

The lengths of the 3 major axes of gravel fragments can be determined by placing the fragments over a grid on an overhead projector of the type found in most modern lecture theatres. The particles are spread on sheets of transparent graph paper with their major and intermediate axes approximately parallel to the surface. The minor axis is determined by rotating the particle around its major axis until the smallest projected area is seen. The accuracy is about 1/4 mm. (Knapp-USGS)

7C. Evaluation, Processing and **Publication**

ON A METHOD OF FLOOD FORECASTING USING A DIGITAL COMPUTER CONNECTED WITH A WEATHER RADAR.

National Research Center for Disaster Prevention,

Tokyo (Japan)

For primary bibliographic entry see Field 02A. W69-08229

A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EF-FECTIVENESS IN SOLVING RUNOFF ANALY-

National Research Center for Disaster Prevention, Tokyo (Japan).

For primary bibliographic entry see Field 02A. W69-08230

ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID OF ELECTRONIC COMPUTERS (FRENCH),

Institute of Hydrotechnical Research, Bucharest (Rumania)

For primary bibliographic entry see Field 02G. W69-08231

SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING FORECASTING PROBLEMS, ROUTING AND FLOOD

Institute of Hydrotechnical Research, Bucharest (Rumania).

For primary bibliographic entry see Field 02E. W69-08232

THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESEARCH AND ITS CON-SEQUENCES,

Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center. For primary bibliographic entry see Field 07A. W69-08233

DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SMALL WATERSHED, Geological Survey, Washington, D. C.

Timothy Steele.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 203-214, 1968. 12 p, 4 fig, 2 tab, 6 ref.

Descriptors: *Water quality, *Water chemistry, *Small watersheds, *Sampling, *Digital computers, Data processing, Data storage and retrieval, Aqueous solutions, Leaching, Weathering, Solutes, Base flow.

Identifiers: San Francisco (Calif).

A program of sampling surface water and analyzing for the major ionic constituents was carried out over a 15-mo period between June 1966 and October 1967, in the Pescadero Creek watershed California. The 46-sq mi coastal basin, about 40 mi south of San Francisco, is relatively free of human habitation and agriculture, but geologically complex. Chemical-quality data from the watershed, despite its complex geology, showed consistent relations with specific conductance. Simple regression equations were developed by graphical or analytical methods, to form the basis of a digitalcomputer program for estimating solute concentrations and loads from discharge data alone. When solute concentrations were plotted against total stream discharge, trends were consistently linear throughout the range of discharges for Na, K, and Cl concentrations, but a characteristic break in trends from low to high discharges was clearly discernible for Ca, Mg, bicarbonate, sulfate, and calculated dissolved-solids concentrations. This may result from the different chemical processes that prevail during base flow under predominantly direct-runoff flow. The linear trends are partly explained by the increasing solute contributions of groundwater in the lower part of the watershed. Concentrations-discharge regression equations were derived for the base-flow component and for the direct-runoff component. Relative proportions of solute concentrations contributing to the specific conductance changed rather abruptly from low- to high-discharge levels. High specific conductances reflected larger percentage contributions by Na and Cl ions and corresponding smaller contributions by Ca and sulfate ions. The approach and methods used in this study might be extended to other small watersheds quite different in geology and climatology in search of correct quantitative interpretation and prediction of the effects of hydrochemical processes in nature. W69-08234

CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES,

California State Dept. of Water Resources. For primary bibliographic entry see Field 04B. W69-08235

PREPARATION, VERIFICATION AND USE OF DIGITAL GROUNDWATER SIMULATION

General Electric Co., Santa Barbara, Calif. TEM-

David Kleinecke.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 224-232, 1968. 9 p, 4

Evaluation, Processing and Publication—Group 7C

Descriptors: *Mathematical models, *Digital computers, *Analog computers, *Synthetic hydrology, *Groundwater basins, Water levels, Water-level fluctuations, Model studies, Aquifers. Identifiers: *Hybrid computers.

The digital computer programs TELMA 1 and TELMA 2 written at General Electric TEMPO for the simulation of groundwater basins are described. These programs have some features of interest not available in other digital simulation programs. Experience in attempting to verify the groundwater flow in an actual basin using TELMA 1 is presented. Available data, both geohydrological and concerning historic recharge and production, can be supplemented most effectively by using a simulation model to guide the collection of new information. The existing data can be much more meaningfully and economically utilized by introducing mathematical optimization techniques as an aid in model building. This approach assumes extensive use of digital computation in the preparation of models but does not preclude the possibility of analog or digital-analog hybrid computers after adequate models have been developed. It is conadequate models have been developed. It is con-cluded that simulation is the only practical way to fully utilize present data and guide the develop-ment of better understanding of groundwater flows both for direct management purposes and as a means of improving geohydrological knowledge. (Knapp-USG\$)
W69-08236

APPLICATIONS OF COMPUTER TECHNOLO-GY TO HYDROLOGIC MODEL BUILDING, Agricultural Research Service, Chickasha, Okla.

Southern Plains Branch.

Southern Frains Statics.

Donn G. De Coursey.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 233-239, 1968. 7 p, 1 fig, 3 tab, 8 ref.

Descriptors: *Computer programs, *Digital com-*Mathematical models, puters, *Optimization, Hydrology, Systems analysis, Parametric hydrology, Streamflow, Discharge (Water), discharge relations, Data processing. Identifiers: Optimization program.

An optimization program useful in hydrologic modeling is described. Conceptual and rational hydrologic models of non-linear form are discussed. Several have implicit components. A self-explanatory and easy program is used to find optimum values of the coefficients. (Knapp-USGS)

A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION,

Utah Water Research Lab., Logan.
John Y. Kwan, J. Paul Riley, and Roger A. Amisial.
Symp on Use of Analog and Digital Computers in
Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci
Hydrol, Pub No 80, Vol 1, pp 240-248, 1968. 9 p, 6

Descriptors: *Computer programs, *Rainfall disposition, *Mapping, *Distribution patterns, *Isohyets, Contours, Weather data, Data processing, Rainfall.
Identifiers: Rainfall data plotting.

A Fortran IV program has been developed to plot isohyetal lines from precipitation data of given stations. Points on the isohyetal lines are determined by linear interpolation between stations. Once the isohyetal points were obtained, their proper sequence was determined. This was performed by starting with a certain point and checking the points successively nearest to it for a permissible connection between the two points. Then the sequence of points was checked for possible looping or connection with other sequences of points of the same precipitation. The isohyetal lines were then smoothed by successive parabolic approximations. Volume of precipitation can be calculated within any specified boundary. It is possible to calculate volumes of precipitation over sub-zones of a given area. The volume is obtained by summing the product of the area between two precipitation lines and the average precipitation value of the lines. The area between the isohyetal lines is found by dividing the region into straight line trapezoidal segments and summing the areas of the trapezoids. (Knapp-USGS)
W69-08238

HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM,

Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center. Leo R. Beard.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 258-267, 1968. 10 p,

Descriptors: *Routing, *Flood forecasting, *Computer programs, Runoff forecasting, Synthetic hydrology, Snowpacks, Snowmelt, Water loss, Hydrograph analysis, Regulation, Urbanization, Rainfall-runoff relationships. Identifiers: U.S. Army Corps of Engineers.

One of the computer packages being developed in The Hydrologic Engineering Center of the Corps of Engineers is the Flood Hydrograph Package, which performs all common operations in deriving and using flood hydrographs entirely in core storage of computers as large as the IBM 7094. One of the problems managed by this program is flood computation throughout an entire stream system in one operation. Ordinarily, a design or hypothetical flood might be derived from a storm centered in the tributary area. After floods are computed in this manner for several subareas within a stream system, it is often necessary to compute floods for the combined areas at various locations. The originally computed floods cannot be routed and combined, since the storm cannot center over all subareas at once. It is ordinarily necessary to recompute each subarea flood for every combining point downstream, and to label each recomputation as the contribution to that particular location. In a complex system, such as a storm drain or major river basin, this procedure would lead to great amounts of computation and considerable confusion. Essential features of the computer package and the simplified stream system analysis are described. (Knapp-USGS) W69-08239

APPLICATION OF COMPUTERIZED OPERA-TIONS RESEARCH TECHNIQUE FOR OP-TIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER PROJECT, California State Dept. of Water Resources. Ad-

vanced Techniques Section.
For primary bibliographic entry see Field 06A.

W69-08240

SOME PROBLEMS OF STREAMFLOW FORECASTS BASED ON INFORMATION THEORY, Research Inst. for Water Resources Development, PROBLEMS OF **STREAMFLOW**

Budapest (Hungary). For primary bibliographic entry see Field 02E.

DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION,

Department of Energy, Mines and Resources, Ottawa (Ontario); and McGill Univ., Montreal

R. L. Pentland, A. B. Rosenberg, and G. S.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, pp 289-299, 1968, 11 p, 5 fig, 6 ref.

Descriptors: *Great Lakes, *Water levels, *Water-level fluctuations, *Regulation, *Digital computers, Data processing, Mathematical models, Model studies, Computer models, Economics, Optimization, Systems analysis, Operations research. Identifiers: Great Lakes regulation, Canada, United

The regulation of one or more of the Great Lakes has been under investigation sporadically for over 50 years by various agencies in Canada and the United States. Only in the last 3 years, however, in an international investigation, has the development and use of computers permitted study of many alternative regulations schemes utilizing all of the lakes while computing economic effects on the diverse interests. The various computer programs used in obtaining the material flow-level model and in deriving and testing forecasting and simulation techniques are discussed. Methodology as applied to the determination of economic effects is also considered in optimizing alternative schemes of regulation. A study of great complexity can be performed within tight scheduling with proper balance of technical personnel and equipment. (Knapp-USGS) W69-08242

AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM RIVER FORECASTS ON THE NORTH COAST OF CALIFORNIA,

Weather Bureau, Sacramento, Calif. River Forecast Center. For primary bibliographic entry see Field 02A. W69-08243

COMPUTATIONAL ANALYSES OF MOISTURE

FLUX OVER NORTH AMERICA, Travelers Research Center, Inc., Hartford, Conn. For primary bibliographic entry see Field 02B.

OPERATIONAL STREAMFLOW FORECASTING WITH THE SSARR MODEL,

Weather Bureau, Portland, Oreg. River Forecast

For primary bibliographic entry see Field 02E. W69-08245

APPLICATION OF STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION--'SSARR'--PROGRAM TO THE LOWER MEKONG RIVER, Corps of Engineers, Portland, Oreg. North Pacific

For primary bibliographic entry see Field 02E. W69-08246

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SMALL GROUPS OR INDIVIDUALS, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Henry W. Anderson, and Theodore B. Yerke. Int Ass Sci Hydrol Publ 81 (1968): 550-560.

Descriptors: *Information retrieval, *Bibliographies, *Publications, Research facilities, Computer programs, Automation, Data storage and retrieval, Hydrologic aspects. Identifiers: Citations, Search, Abstracting, Com-

puter aided documentation.

Computer programs have been developed which will allow the individual researcher, forester, or engineer to classify, store, and retrieve literature, abstracts, meeting notes etc. Use of one of the programs, the 'search program' in preparing a summary of sedimentation research in the U. S. is illustrated. Included is a discussion on what to document, indexing for information retrieval, and abstracting techniques. A list of 17 sources of keywords and descriptors of hydrologic and related terms is appendixed. W69-08511

Group 7C—Evaluation, Processing and Publication

SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY: RAINFALL AND RUNOFF,

Universidad Nacional del Zulia, Maracaibo (Venezuela); and Geological Survey, Fort Collins,

For primary bibliographic entry see Field 02A. W69-08572

SUGGESTIONS ON COMPILATION OF SMALL SCALE HYDROGEOLOGICAL MAPS,

Sen So-yung.

Int Geol Rev, Vol 11, No 4, p 419-427, Apr 1969. 9 p, 16 ref, append. Transl from Acta Geol Sinica, Vol 45, No 3, pp 325-336, 1965.

Descriptors: *Hydrogeology, *Mapping, *Ground-water, *Surface waters, Distribution patterns, Hydrography, Surveys, Terrain analysis, Streams, Lakes, Aquifers, Water levels. Identifiers: Hydrogeological maps, China.

Regional hydrogeological maps may be divided into 2 types, those expressing complex, and those expressing special factors. Complex small scale regional hydrogeological maps (1:1,000,000 and less) should expose the main features of regional hydrogeology, but also provide sufficient informa-tion to show concrete hydrogeological conditions. When distinguishing 'regional hydrogeological types,' we must take into account the geomorphological conditions, lithology and occurrence of aquifers, water quality, depth of underground water tables, underlying aquifers, special hydrogeological phenomena (salinization and swamping of soils, areas of artesian flow, etc.) and geological age 61 types of genesis of aquifers. Hydrogeological divisions include hydrogeological regions, subregions, terrains, and subterrains. The regional hydrogeological types are to be shown on the map by using different colors and tints and with various patterns as well; areas of hydrogeological divisions are to be traced only with boundary lines. (Knapp-USGS) W69-08595

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 6. MISSOURI RIVER BASIN.

Geological Survey, Washington, D. C.

Geol Surv Water-Supply Pap No 1916, 1969. 800 p, I fig, I plate.

Descriptors: *Data collections, *Hydrologic data, *Water supply, *Missouri River, Montana, Wyoming, North Dakota, Streamflow, Discharge (Water), Gaging station, Stream gages, Surface

Identifiers: *Missouri River Basin.

Records of stage, discharge, and content of lakes, streams, and reservoirs in the Missouri River Basin above Williston, North Dakota, 1961-1965, are compiled. The data are intended to be used to calculate water supplies for irrigation, municipal, industrial, and other uses. (Knapp-USGS) W69-08605

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAM-FLOW REGULATION,

State Hydrological Inst., Leningrad (USSR). Ye G. Blokhinov, and O. V. Sarmanov.
Soviet Hydrol: Selec Pap, Issue No 1, p 36-54, 1968. 19 p, 7 fig, 2 tab, 5 ref. From Trudy Gos Gidrol Inst, No 143, p 110-133, 1968.

Descriptors: *Statistical methods, *Correlation analysis, *Water management (Applied), Reservoir operation, *Reservoir design, Streamflow forecasting, Regulation.
Identifiers: *USSR, Gamma correlation.

The use of gamma distribution computation in correlating streamflow to make water management decisions is discussed. The main characteristics of a two-variate gamma distribution and working relationships needed for practical purposes are presented for a symmetric case, that is, when the values being correlated have the same parameters. The order in which the gamma correlation is used in computations of long-term streamflow regulation for selected major reservoir parameters is examined and an estimate is given of the possible water management effect obtained from its use. (K-W69-08612

PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTATIONS OF STREAMFLOW REGULATION, State Hydrological Inst., Leningrad (USSR).

D. Ya. Ratkovich.

Soviet Hydrol: Selec Pap, Issue No 1, p 55-79, 1968. 25 p, 7 fig, 3 tab, 8 ref. From Trudy Gos Gidrol Inst, No 143, p 76-105, 1968.

Descriptors: *Statistical methods, *Correlation *Stochastic processes, analysis, *Markov *Water management processes. (Applied), Streamflow forecasting, Regulation, Reservoir operation.

Identifiers: Streamflow regulation.

The probability distribution of groups of various durations in limited samples of independent random values relative to some fixed value of a random quantity coincides with relationships characteristic of the population, provided the ends of a sample close circularly. This makes it possible to determine to what degree the results of water management computations, based on calendar series of hydrologic values, are free of systematic errors. The probability distribution depends on the number of terms in a sample and deviates more from relationships characteristic of the population in shorter samples. To verify the hypothesis that annual streamflow series can be regarded as sequences of independent random values, we must compare the distribution of groups of various duration in samples of independent random values with the recurrence of groups of dry and wet years actually observed in rivers. The distribution of groups of dry and wet years may differ from each other and differ in rivers that differ in flow formation conditions or belong to different physiographic re-gions. (Knapp-USGS) W69-08613

SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC SERIES.

State Hydrological Inst., Leningrad (USSR). S.N. Kritskiy, and M. F. Menkel. Soviet Hydrol: Selec Pap, Issue No 1, p 80-98, 1968. 19 p, 1 fig, 16 ref. From Trudy Gos Gidrol Inst, No 143, p 110-133, 1968.

Descriptors: *Statistical methods, *Correlation analysis, *Probability, *Streamflow forecasting, Sampling, Regression analysis, Parametric hydrology, Water management (Applica), Markov processes, Stochastic processes. Water management (Applied), Regulation, Identifiers: Gamma distributions.

Some relationships between probability distribution parameters and method of estimating paramethat allow for the relatively small volume of samples and the correlation between contiguous terms are examined. The use of regression to reduce the characteristics of flow series to longperiod values, the correlations between contiguous terms of simple Markov chains and their differences, and the refinement of formulas of standard errors in a sample estimate of the parameters of a gamma distribution are discussed. (Knapp-W69-08614

USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES,

Gruzinskii Politekhnicheskii Institut. (USSR).

G. G. Svanidze.

Symp on Use of Analog and Digital Computers in Hydrol, Tucson, Ariz, Dec 1968, Int Ass Sci Hydrol, Pub No 80, Vol 1, p 249-257, 1968. 9 p, 3 fig, 1 tab, 14 ref.

Descriptors: *River forecasting, *Stochastic processes, *Mathematical models, *Statistical models, *Digital computers, Synthetic hydrology, Streamflow forecasting, Monte Carlo method, Time series analysis, Runoff forecasting, Markov Identifiers: USSR.

Viewing river runoff as a nonstationary stochastic process, the methods of modelling long hydrological series with the aid of digital computers are discussed. The mathematical techniques employed are the theory of random functions, the theory of Markoff processes, and the Monte Carlo method. Modelling with discrete and with continuous time are considered. The limited range of initially available data for one basin is supplemented by means of joining data for a number of rivers with introduction of a few hypotheses. Suggestions are made as to the choice of the necessary length of the series or of the number of short-length realizations for obtaining results within the prescribed confidence intervals. Methods of group modeling (vector problem) of interdependent hydrological series are also discussed. (Knapp-USGS) W69-08624

08. ENGINEERING WORKS

8A. Structures

AUTHORIZATION, CONSTRUCTION MAINTENANCE OF BRIDGES.

SC Code Ann secs 33-601, 33-608, 33-609, 33-614, 33-615 (1962).

Descriptors: *South Carolina, *Bridges, *Administrative agencies, *Transportation, Rivers, Streams, Boundaries (Property), Costs, Legal Bridge construction, Structures, Dams, Mill dams, Civil engineering, Interstate rivers, Equitable apportionment, Interstate, State governments, Local governments.

The State Highway Commission may cooperate with adjoining states in the construction and main-tenance of bridges across streams constituting boundaries between this state and any such adjoining state. It may expend for such purposes not more than one half the costs and bear a proportionate part of the maintenance. The cost of construction, repair and maintenance of bridges across waters constituting the boundary between two counties shall be borne equally by both counties. Any two or more counties desiring to build a bridge across any stream may enter into combination and form a bridge district. Whoever shall willfully injure any bridge built by the authority of the commissioners of two counties shall be punished as ordered by the or two counties shall be punished as ordered by the court of general sessions in the county of the offense. Whoever shall injure any other public bridge shall be guilty of a misdemeanor. All owners of mill dams and bridges, over which a public highway passes, shall keep such in good repair. (Helwig-Fla) W69-08170

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ALABAMA.

Corps of Engineers, Atlanta, Ga.

Corps Eng Water Resources Develop Rep, Jan 1969. 59 p, 6 fig, 55 photo, 1 map, 1 tab, index.

Descriptors: *Water management (Applied),
*Alabama, *Water resources development, National Nat

U.S. Army Corps of Engineers water resources development projects in Alabama are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply,

water pollution, power, recreation, and flood plain studies. (Knapp-USGS) W69-08600

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN IDAHO.

Corps of Engineers, Portland, Oreg., North Pacific

Corps Eng Water Resources Develop Rep, Jan 1969, 46 p, 4 fig, 32 photo, index.

Descriptors: *Water management (Applied), *Idaho, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.

Identifiers: U S Army Corps of Engineers projects

(Idaho).

U. S. Army Corps of Engineers water resources development projects in Idaho are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies. authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (K-napp-USGS) W69-08601

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARKANSAS.

Corps of Engineers, Vicksburg, Miss. Lower Mississippi Valley Div.

Corps Eng Water Resources Develop Rep, Jan 1969. 104 p, 3 fig, 42 photo, 1 map, index.

Descriptors: *Water management (Applied), *Arkansas, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.

Identifiers: U S Army Corps of Engineers projects

U. S. Army Corps of Engineers water resources development projects in Arkansas are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS) W69-08602

WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF ENGINEERS IN INDIANA.

Corps of Engineers, Cincinnati, Ohio. Ohio River

Corps Eng Water Resources Develop Rep, Jan 1969. 72 p, 29 photo, 1 map, index.

Descriptors: *Water management (Applied), *Indiana, *Water resources development, Navigation, River basin development, Flood control, Multiplepurpose projects, Hydroelectric power, Dams, River training. Identifiers: U S Army Corps of Engineers projects

U. S. Army Corps of Engineers water resources development projects in Indiana are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies. authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollu-tion, power, recreation, and flood plain studies. (K-napp-USGS) W69-08603

8B. Hydraulics

UNSTEADY FLOW IN A RESERVOIR-CON-DUIT SYSTEM,

Kansas Univ., Lawrence; and Whirlpool Corp., St. Joseph, Mich.

Yun-Sheng Yu, and Mack H. Gray, III.
OWRR Project No A-017-KAN. Water Resources
Res, Vol 5, No 3, pp 660-672, June 1969. 13 p, 8
fig, 4 tab, 11 ref.

Descriptors: *Unsteady flow, *Closed conduit flow, Pipe flow, Reservoirs, Hydraulics, Hydraulic structures, Velocity, Flow, Pressure, Reynolds number.

Identifiers: Pipe-flow acceleration.

The one-dimensional method of solution computes successfully the instantaneous average displacement, velocity, and acceleration of fluid in a pipe connected to a reservoir, and the water depth in the reservoir when a valve at the end of the pipe is suddenly opened. Measurements of the instantaneous average fluid displacement in the pipe for different values of B/D (reservoir diameter to pipe diameter) agree very well with the computed values. For a specific inlet geometry and a given value of the ratio of pipe length to pipe diameter, the lumped inertial parameter decreases as B/D increases and reaches a minimum value as B/D becomes infinity. The neglect of the inertia of fluid in the reservoir in computing the unsteady flow characteristics is justifiable if B/D is larger than 90 and L/D much arger than 0.47. (Knapp-USGS) W69-08202

A NONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND CANALS, Mississippi State Univ., State College. Dept. of Agricultural and Biological Engineering. B. P. Verma, and J. C. McWhorter. Completion Report, Mississippi Water Resources Research Institute, July, 1969. 37 p, 3 tab, 4 fig, 7 ref, 1 append. OWRR Project A-024-MISS.

Descriptors: *Dimensional analysis, *Uniform flow, *Open channel, Flow equation.

This study develops a reliable relation for describing uniform turbulent flow of water in flumes and canals. The study involves: A dimensional analysis using the physical quantities which apply to the common case of uniform turbulent flow in a prismatic open channel; the conduct of a uniform flow experiment; the analysis of the data in order to establish a prediction equation that describes uniform flow; and the comparison of the prediction equation with data obtained from the literature on uniform flow in flumes and canals. The analysis of experimental flume data and data compiled from the literature produced a prediction equation, the form of which, describes the case of uniform flow without relying upon constants which are dimensionally questionable. W69-08398

BASIC STUDY OF JET FLOW PATTERNS RE-LATED TO STREAM AND RESERVOIR

BEHAVIOR, Illinois Univ., Urbana. W. Hall, C. Maxwell, and H. Paxwash.

Water Resources Center, Research Report No 10, July 1967. 63 p. OWWR Project A-010-Ill.

Descriptors: *Diffusion, *Flow characteristics, *Flow profiles, *Free surfaces, Air-water interfaces, *Jets, Boundary (Surfaces), Hydraulics, Interfaces.

The effect of a nearby free surface on jet flow is studied experimentally. Parameters varied included nozzle diameter, submergence, and discharge. The jets were discharged into still ambient fluid of the same density. The maximum velocity is found to move upward as the jet proceeds downstream eventually reaching the surface. The resultant wave action modified flow patterns in the upper region of the jet, though the velocity distribution in the lower portion resembles that for deeply submerged jets. The location of the filaments of maximum velocity was found to be a function of both absolute submergence as well as submergence relative to the nozzle diameter. Intakes placed near the nozzle had no measurable influence on jet flow patterns. (Benedict-Vanderbilt) W69-08403

ON A MOMENTUM-MASS FLUX DIAGRAM TURBULENT JETS, PLUMES AND WAKES,

Manchester Univ. (England).

B. R. Morton.

Journal of Fluid Mechanics, Part I, Vol 10, p 101-112, Feb 1961. 4 fig, 7 ref.

Descriptors: *Jets, *Buoyancy, Continuity equa-tion, Momentum equation, Mathematical model, Hydrodynamics, Turbulent flow, Eddies, Reynolds

Identifiers: *Entrainment, Momentum flux, Mass flux, Wakes, Analytic solution, Density deficiency, Virtual source, Top-Hat profiles, Drag coefficient, Similarity assumptions, Buoyant plumes.

Many salient features of fully developed turbulent jets, plumes and wakes with steady mean flow can be shown clearly by the relationship between the momentum flux and the mass flux in the column of moving fluid. Using a simple model for the flows, this relationship can be theoretically predicted from the solution of a single ordinary differential equation, and the character of many related flows can be represented on a single momentum-mass flux diagram. Theoretical turbulent jets and wakes in a still fluid environment and in a steady ambient stream are represented on the same mass-momentum flux diagram along with buoyant wakes and plumes (buoyant jets). Chosen as examples are (1) a negatively buoyant jet of heavy fluid with strong deceleration, (2) a weaker negatively buoyant jet, (3) a buoyant jet with very weak negative buoyant jet, (3) a buoyant jet with very weak negative buoyant cy, (4) a positively buoyant jet, (5) a forced wake, and (6) a more weakly buoyant forced wake showing transition to jet flow at a distance. Also presented are curves for the dimensionless velocity excess in the jet relative to the ambient fluid and for the dimensionless jet radius plotted against dimensionless distance from a virtual source. The author suggests that the value of the entrainment coefficient, defined as the ratio of the inflow velocity to the velocity difference between jet and ambient flows, is approximately 0.116. (Motz-Vanderbilt) W69-08410

DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SUR-

Chuo Univ., Tokyo (Japan).

T. Hayashi, and N. Shuto.
Proceedings: Twelfth Congress of the International
Association for Hydraulic Research, Colorado
State Univ., Fort Collins, Colorado, Vol 4, Part 1,
pp 47-59, Sept 1967. 13 p, 14 fig, 4 tab, 6 ref.

Descriptors: *Jets, *Froude number, *Buoyancy, Continuity equation, Momentum equation, Energy equation, Mathematical model, Hydrodynamics, Heat, Heat transfer, Specific heat, Thermodynamic

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

behavior, Latent heat, Vapor pressure, Wind velocity, Dye releases, Reynolds number, Turbulent flow, Convection, Temporal and spatial distributions.

Identifiers: *Entrainment, *Richardson number, *Horizontal surface jet, Similarity assumptions, Back radiation, Stefan-Boltzmann law, Lab data.

Experiments are performed on the diffusion of warm water jets discharged horizontally at the surface of quiescent water. The initial temperature difference between the jet and the ambient fluid varies from 0.2 to 28 deg C., the densimetric Froude number at the jet outlet varies from 16.1 to 1.4, and the Richardson number (Ri) at the jet outlet varies from 0.00 to 0.54. An approximate theory is developed with the main assumptions that: (1) The horizontal diffusion terms in the equation of motion equal the horizontal pressure gradient term; (2) The profiles of temperature in vertical sections are similar and the profiles of horizontal velocity in vertical sections are also similar; (3) The rate of entrainment at the bottom of the surface layer of warm water is proportional to some characteristic velocity at that vertical plane; (4) The turbulent-diffusion coefficients are constants. An approximate solution is presented for the case of the Ri number greater than 1, or for the case of no vertical entrainment. The experimental results are compared with the predicted results, and the effect of the Ri number on the diffusion of warm water jets is noted. When the Ri is greater than 1, surface heat exchange is important; when the Ri is less than 1, vertical entrainment is important. (Motz-Vanderbilt) W69-08412

SELECTIVE WITHDRAWAL FROM DENSITY -STRATIFIED RESERVOIRS,

California Inst. of Tech., Pasadena For primary bibliographic entry see Field 05C W69-08419

SURFACE DISCHARGE OF HORIZONTAL WARM-WATER JET,

For primary bibliographic entry see Field 05B. W69-08421

BOUYANT JETS OR FLOWING A TURBULENT AMBIENT STRATIFIED OR FLUIDS.

California Inst. of Tech., Pasadena. For primary bibliographic entry see Field 05B. W69-08423

NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS, California Inst. of Tech., Pasadena.

For primary bibliographic entry see Field 05B. W69-08424

ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL FLOW

California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 02E.
W69-08589

PROPAGATION OF FLOOD WAVES IN OPEN CHANNELS, Minnesota Univ., Minneapolis. St. Anthony Falls

Hydraulic Lab For primary bibliographic entry see Field 02E W69-08590

8C. Hydraulic Machinery

DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE,

Kaiser Engineers, Oakland, Calif. For primary bibliographic entry see Field 03A. W69-08295

LUENING V PUBLIC SERVICE COMMISSION (PERMIT TO CONSTRUCT HYDROELECTRIC

267 Wis 537, 66 NW 2d 190-192 (1954).

*Wisconsin, *Dams, *Canals. *Hydroelectric plants, Discharge, Hydroelectric power, Dam construction, Rivers, Navigation, Navigable waters, Public rights, Public health, Permits, Natural flow, Riverbeds, Boating, Fishing, Legal aspects, Judicial decisions, Administrative agencies, Local governments. Identifiers: Rapids.

Plaintiffs instituted suit to review an order issued by the public service commission granting a permit to construct a dam and canal for hydroelectric purposes. The plaintiffs contended that the commission could not authorize the construction of the canal and were only empowered to authorize the construction of a dam across the river bed. The court held that the term 'dam' is not limited to the structure across the river bed but includes the canal which carries the water through the generating plant and back to the river bed. The court held that if the commission found, after a hearing, that the proposed dam would not interfere with navigation or violate other public rights, that it could grant a permit. The evidence adduced at the hearing indicated that the river was not suited for boating and fishing and thus substantiated the commission's conclusions. The court determined that the proposed canal could be used for navigation and thereby replace the river in that respect. The action of the public service commission was upheld. (Shevin-Fla) W69-08319

LIMITATION OF HYDRO-ELECTRIC CHAR-

For primary bibliographic entry see Field 06E. W69-08344

09. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

FEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS,

Federal Water Pollution Control Administration, Washington, D. C. For primary bibliographic entry see Field 05G. W69-08555

10. SCIENTIFIC AND TECHNICAL INFORMATION

A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION

Federal Water Pollution Control Administration, Washington, D. C. Research Committee. For primary bibliographic entry see Field 05D. W69-08199

DATA SYSTEMS AND RETRIEVAL ADAPTABLE INFORMATION WATER TO RESOURCES.

Economic Research Service, Washington, D.C. Resource Data Systems Group.

Paul L. Holm. Agricultural Law Center, College of Law, The University of Iowa, Monograph No 10, p 108-121, Sept. 1968. 14 p, 1 fig, 4 ref.

Descriptors: *Information retrieval, *Data storage

and retrieval, *Data collections.
Identifiers: *Water Resources Regional Agricultural Analysis and Projections System.

An information retrieval system is used for locating and selecting, on demand, certain documents or other graphic records containing information rele other graphic records containing information relevant to a given requirement form a file of such materials. There are three classifications of these systems: (1) data base, (2) reference, and (3) text processing systems. Describes briefly certain systems in operation, or under development, including those of the Office of Water Data Coordination and the Water Resources Scientific Information Content A data systems in designed to least. mation Center. A data system is designed to locate, select, and process data elements according to a standard set of decision rules. Data is unprocessed or raw information. There are two classifications of these systems: (1) data banks and (2) analytical data systems. The author identifies some urgent tasks to be deliberated by an ad hoc task group on approaches to research on water use data. (Grossman-Rutgers) W69-08389

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SMALL GROUPS OR INDIVIDUALS, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. For primary bibliographic entry see Field 07C. W69-08511

HYDROLOGIC DATA SYSTEMS--DEVELOP-ING CONCEPTS.

Geological Survey, Washington, D. C. For primary bibliographic entry see Field 07A. W69-08606

SUBJECT INDEX

ABBASION
ELECTRON HICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL
ABRASION FRATURES ON QUARTZ SAND GRAINS,
W69-08607
02J FLOOD CONTROL PROJECTS. 06 R AUTHORIZATION, CONSTRUCTION AND MAINTENANCE OF BRIDGES. ACCESS ROUTES GUESS V AZAR (RIGHT OF WAY ACROSS PRIVATE PROPERTY). W69-08322 06E ROCKEFELLER V HOGUE (REMOVAL OF GAME AND FISH COMMISSIONERS). ACCIDENTS
SUITS FOR INJURIES ON HIGHWAY.
W69-08171 W69-08185 STATE OF NEW HAMPSHIRE V ATOMIC EMERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC). W69-08316 06E ACCRETION(LEGAL ASPECTS)
BALDWIN V ANDERSON (TITLE TO LAND FORMED BY AVULSION OR ACCRETION). INTERSTATE WATER COMPACT. W69-08191 068 06E GARRISON FURNITURE CO. V SOUTHERN ENTERPRISES, INC. WILDLIPE MANAGEMENT. W69-08326 (AVULSION). W69-08374 NATURAL RESOURCES. W69-08335 06R IN AID WAILS SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MIN₹ WATER, W69-08400 05D CONSTRUCTION OF IMPROVEMENT. 04A BIOLOGICAL OXIDATION RATES IN MINE ACID WATER REGIMES, W69-08379 05G POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA. TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH ACID KAOLINITIC SOIL, w69-0828 02P DAMS IN DISREPAIR AND CHANNEL IMPROVEMENT. SOIL CONSERVATION AND IMPROVEMENT. W69-08370 ACIDIC WATER
CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN
THE NEUTRALIZATION OF ACID STREAMS, 04D AERATION
WATER TABLE, SOIL MOISTURE, AND OXYGEN DIPPUSION
RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, ACIDITY
AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, W69-08466 05D WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 ACID-TOLERANT BACTERIA
SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE RESEARCH ON TREATMENT OF DIE WASTES, W69-08558 AERIAL PHOTOGRAPHY
AREAL EXTENT OF SNOW COVER IN RELATION TO STREAMPLOW IN
CENTRAL COLORADO,
M69-08454
02C ACQUISITION OF A CERTAIN DAM AND WATER RIGHTS. GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, ACT OF GOD SMITH V BOARD OF COUNTY ROAD COMMISSIONERS OF CHIPPENA COUNTY (FLOOD DANAGE CAUSED BY ROAD CONSTRUCTION AND ACT OF WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 ACTINOHYCETES
ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2HETHILBORNANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL BESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND HONROVIA (FRENCH), W69-08255 ACTINOMYCETES, W69-08219 ACTIVATED SLUDGE
TREATING WASTES IN A WATER-SHORT AREA,
W69-08551 05D AGAVE SISALANA NAVE SISALANA
WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS,
W69-08303 AIDS TO NAVIGATION
LIGHTHOUSES AND OTHER AIDS TO NAVIGATION.
W69-08181 06E ADJUDICATION PROCEDURE

ROCKEPELLER V HOGUE (REHOVAL OF GAME AND FISH *

COMMISSIONERS).

W69-08185 06E AIR TEMPERATURE
THE WEATHER AND CLIBATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES,
W69-08448
02C PROCEDURE TO ESTABLISH DISTRICTS. AIRCRAFT UNDERGROUND GAS STORAGE. #69-08137 04A ADMINISTRATION
DANS AND FLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE WATER RESOURCES BOARD). 06 E ALABAMA
WATER CONSERVATION AND IRRIGATION CORPORATION.
W69-08129
06E SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF PTELD, W69-08381 ENGINEERS IN ALABAMA. W69-08600 ECONOMIC AND RELATED PROBLEMS IN CONTEMPORARY WATER ALASKA
HEAT BALANCE STUDIES DURING AN ICE-POG PERIOD IN PAIRBANKS, RESOURCES MANAGEMENT, W69-08384 ADMINISTRATIVE AGENCIES
POWERS AND DUTIES OF THE COMMISSIONER OF CONSERVATION. NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA, W69-08249 02J DRAINAGE DISTRICTS UNDER 1911 ACT. #69-08152 MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN ACQUISITION OF A CERTAIN DAM AND WATER RIGHTS. ALASKA, W69-08272 SAVANNAH RIVER NAVIGATION COMMISSION. N69-08160 06E

ALGAE AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS,

W69-08278 0.28

OLEFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,

SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITANS AND S

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE ANCHOYY (ANCHOA LAMPROTAFMIA HILDEBRAND), ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA PLABELLUM LAMOUROUX),

BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,

ALGAE CONTROL
PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER SUPPLIES 050

ALKALINITY SEASONAL VARIATION IN ALKALINITY IN PANS IN CENTRAL AFRICA,

ALLUVIAL CHANNELS
STRRAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE, W69-08258
02J

ALTERATION OF PLOW THOMAS V LACOTTS (REASONABLE USE OF RIPARIAN WATERS). W69-08133 06E

CREEKS OR RUNS WIDENING, STRAIGHTENING, ETC.

AMPHIPODA THE EFFECT OF TEMPERATURE, SEDIMENT, AND PEEDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,

ANACYSTIS MONTANA
OLEPINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,
W69-08284
05a

ANAEROBIC CONDITIONS TREATMENT OF HIGH NITRATE WATERS, W69-08228

ANARROBIC CONTACT PROCESS
TREATING WASTES IN A WATER-SHORT AREA, W69-08551

ANAEROBIC DIGESTION WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556

ANALOG COMPUTERS
ON A METHOD OF FLOOD FORECASTING USING A DIGITAL COMPUTER
CONNECTED WITH A WEATHER RADAR,

 λ COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR REFECTIVENESS IN SOLVING RUNOFF ANALYSIS, $0.2\,\lambda$

PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIBULATION PROGRAM, W69-08236

ANALOG MODELS WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., W69-08299

ANALYTICAL METHODS
AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK

07A

MULTIVARIATE STATISTICAL METHODS IN HIDROLOGY-A COMPARISON USING DATA OF KNOWN FUNCTIONAL RELATIONSHIP, 1078

WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, 02A

IMPORTANT WATERSHED CHARACTERISTICS APPECTING WATER YIELD, PLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION, 04D

DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC W69-08559

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGHOSE ANCHOYY (ANCHOA LAMPROTAEMIA HILDEBRAND), ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA PLABELIUM LANGUROUX), W69-08525 0.5C

ANOXIC ENVIRONMENTS WITROGEN FIXATION IN SOME AMOXIC LACUSTRINE ENVIRONMENTS, W69-08280 ANTITRANSPIRANTS ANTITERINFEIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, W69-08210

PEALS AND PLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIFE WATER RESOURCES BOARD).
W69-08345

APPROXIMATION METHOD
SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE FLOW PROBLEM, W69-08575

AQUATIC ENVIRONMENT
CONDITIONS FOR CORXISTENCE OF AQUATIC COMMUNITIES WITH THE EXPANDING NUCLEAR POWER INDUSTRY, w69-08420

AQUATIC HABITATS
MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN ALASKA, W69-08272

AQUEOUS SOLUTIONS TRANSFER OF OXYGEN IN AQUEOUS SOLUTIONS W69-08217

AQUIFER CHARACTERISTICS
THE APPLICATION OF GEOBLECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,

GROUND WATER OF THE WESTERN DESERT IN IRAQ,

SURFACE-WATER INFILTRATION AND GROUNDWATER MOVEMENT IN ARID ZONES OF VENEZUELA, W69-08306 04B

AOUIPERS GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESE), W69-08248 02F

SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS W69-08265

INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, W69-08550 02P

GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY HOLE, GARFIELD COUNTY, COLORADO, 02P

ARCTIC
PRECIPITATION IN NORTHERN QUEBEC AND LABBADOR
EVALUATION OF MEASUREMENT TECHNIQUES,
W69-08587 02B

ARID CLIMATES POTENTIAL EVAPOTRANSPIRATION IN HUMID AND ARID CLIMATES, W69-08310

THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS, W69-08297 07B

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIPER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-08625

EFFECT OF HEAVY LATE-PALL PRECIPITATION ON RUNOFF FROM A CHAPARKAL WATERSHED, W69-08285

WASTEWATER REUSE AT THE GRAND CANYON, 050

WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., W69-08299 02F

INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID BASIN AREZONA, U.S.A., W69-08300 02F

THOMAS V LACOTTS (REASONABLE USE OF RIPARIAN WATERS). W69-08133

ARKANSAS STATE HIGHWAY COMB V CARRUTHERS (DAMAGES IN EMINENT DONAIN PROCEEDING). W69-08184

ROCKEFELLER V HOGUE (REMOVAL OF GAME AND FISH COMMISSIONERS). W69-08185

GARRISON FURNITURE CO. V SOUTHERN ENTERPRISES, INC. (AVULSION).

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARKANSAS.

ARK-BOD SUBJECT INDEX

W69-08602

ARTIFICIAL RECHARGE
SOIL RESPONSE TO SEWAGE EFFLUENT IRRIGATION,
W69-08616 05D

GROUNDWATER RECHARGE WITH TREATED MUNICIPAL EFFLUENT, W69-08620

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-08625

KOSTON V TOWN OF MEMBURGE (WATER DISTRICT ASSESSMENT).

ATMOSPHERIC PHYSICS
AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE,

ATOMIC ENERGY COMMISSION
STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC).

05G

ALANCHES TRCHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS AND FUTURE PROSPECTS, W69-08444 02C

SNOW AVALANCHES ALONG COLORADO MOUNTAIN HIGHWAYS, W69-08445

SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN UNITED STATES,

A MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES,

THE WEATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES, W69-08448

AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE,

AVIILSTON BALDWIN V ANDERSON (TITLE TO LAND FORMED BY AVULSION OR ACCRETION). W69-08191

BACKGROUND RADIATION
MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN

ALASKA. W69-08272

BACTERIA
BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS
IN THE ROSS BARNETT RESERVOIR,
W69-08563
05B

CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS, W69-08376 5G

BASE PLOW PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN WISCONSIN, U69-08205

BEACH EROSION SOIL CONSERVATION AND IMPROVEMENT. W69-08370 040

BEACHES
ELECTRON HICROSCOPY OF CHEMICAL SOLUTION AND RECHANICAL ABRASION PEATURES ON QUARTZ SAND GRAINS, W69-08607 02J

PPRBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAEOCURRENTS, W69-08608

JURISDICTION OVER OFFSHORE WATERS AND SUBHERGED LANDS. W69-08315

BEDS UNDER WATER POWERS OF THE GOVERNOR AND COUNCIL. W69-08193 06E

BENTHIC PAUNA
THE EFFECT OF TEMPERATURE, SEDIMENT, AND PEEDING ON THE
BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,
05C

TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS, W69-08528

BIBLIOGRAPHIES
A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.

STATUS OF RADIOACTIVE WASTE DISPOSAL IN U.S.A.,

05E W69-08214

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SMALL GROUPS OR INDIVIDUALS, W69-08511

DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENIMETOK AND BIKINI ATOLS, AUGUST 1964,

BIMINI(BAHAMAS)
SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION THEIR IMPLICATION ON DIAGENESIS,

BIOCHEMICAL OXYGEN DEMAND
WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION,
W69-08556
05D

BIOLOGICAL COMMUNITIES

LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS
ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL,
M69-08611

05C

BIOLOGICAL TREATMENT
BIOLOGICAL OXIDATION RATES IN MINE ACID WATER REGIMES, W69-08379 05G

RESEARCH ON TREATMENT OF DYE WASTES, W69-08558

BIOMASS
PRODUCTION OF JUVENILE STEELHEAD TROUT IN A FRESHWATER

ANNUTTO V VILLAGE OF HERKIMER (MUNICIPAL LIABILITY FOR BLASTING CAUSING PLOOD DAMAGE). W69-08368

BLUEGILL UPPLIENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN METABOLISM OF BLUEGILL SUNFISH,

DIVISION OF PARKS AND RECREATION. W69-08317 06E

BOATING REGULATIONS
EQUIPMENT AND OPERATION OF VESSELS.
W69-08347

06 E

AIRCRAFT UNDERGROUND GAS STORAGE. W69-08137 06 E EQUIPMENT AND OPERATION OF VESSELS. W69-08347

06E

BODIES OF WATER
SHORE EROSION CONTROL DISTRICTS.
W69-08333

WATER QUALITY AS APPRICTED BY A WYOMING MOUNTAIN BOG, W69-08455

GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, W69-08457

EVAPOTRANSPIRATION AT A WYOHING MOUNTAIN BOG, W69-08458 02D

BOTRYOCOCCUS BRAUNII
OLDFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,

BOUNDARIES(PROPERTY)
LEGAL PENCES WATERS, WHEN NOT SUPPLICIENT FENCE.
W69-08363
06E

BOUNDARIES (SURFACES)
UNITED STATES V STATE OF LOUISIANA (LOUISIANA BOUNDARY CASE). W69-08134

INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND HULTILEVEL OPTIMIZATION, W69-08550 02F

BOUNDARY DISPUTES
UNITED STATES V STATE OF LOUISIANA (LOUISIANA BOUNDARY
CASE).
M69-08134
06E

LEGAL PENCES WATERS, WHEN NOT SUFFICIENT PENCE.

BOUNDARY LAYERS ATMOSPHERIC HUMIDITY MEASUREMENT NEAR THE SNOW SURFACE, N69-08452 02C

DYANT JETS
TURBULENT BOUTANT JETS INTO STRATIFIED OR FLOWING AMBIENT
PLUIDS,
W69-08423
058

NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS,

THE SEDIMENTOLOGY OF A BRAIDED RIVER, 02J

BRIDGE CONSTRUCTION
HIGHWAYS (USE OF LANDS UNDER DELAWARE RIVER).
W69-08165
06E

AUTHORIZATION, CONSTRUCTION AND MAINTENANCE OF BRIDGES. W69-08170

SUITS FOR INJURIES ON HIGHWAY.

06 E

CONSTRUCTION AND REPAIR OF BRIDGES AND DRAINAGE SYSTEMS. 0.69 - 0.8320

DELAWARE RIVER AND BAY AUTHORITY. W69-08356

NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES, W69-08562

REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING OF OAK-MOUNTAINMAHOGANY CHAPARRAL, M69-08470

IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL OF CHAPARRAL, W69-08483

EFFECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER

BURNED CHAPARRAL TO GRASS EARLY EFFECTS ON WATER AND SPDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN ARTZONA

HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND BIRCHLEAF MOUNTAINMAHOGANY, W69-08486 0.3B

BULK DENSITY HYDROLOGIC PROPERTIES OF PEAT PROM A WYOMING MOUNTAIN BOG, W69-08456

BULLHEADS DETERMINATION OF FEEDING CHRONOLOGY IN FISHES, W69-08514

ON A HOMENTON-MASS FLUX DIAGRAM FOR TURBULENT JETS, PLUMES 08B

DIPPUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE W69-08412

BUOYS
INTERFERENCE WITH NAVIGATION, ETC. W69-08372

MAING REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING OF OAK-HOUNTAINMAHOGANY CHAPARRAL, ₩69-08470

SHRUB SEEDLING REGENERATION AFTER CONTROLLED BURNING AND HERBICIDAL TREATHENT OF DENSE PRINGLE HANZANITA CHAPARRAL, M69-0847 021

RAINPALL AND STREAMPLOW FROM SMALL TREE-COVERED AND PERN-COVERED AND BURNED WATERSHEDS IN HAWAII, W69-09510 02g $\,$

CALIBRATIONS
CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA
AUTOMATICALLY RECORDING SETTLING TUBE,
M69-08583
07B

RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, W69-08215

CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIM MANAGEMENT STUDIES,

AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM BIVER PORECASTS ON THE WORTH COAST OF CALIFORNIA, W69-08243

NADA
THE SEDIMENTOLOGY OF A BRAIDED RIVER,
02J

CANAL CONSTRUCTION
KINGERY V REEVES (EASEMENT FOR IRRIGATION CANAL).
M69-08538
06E

CANALS
LUENING V PUBLIC SERVICE COMMISSION (PERMIT TO CONSTRUCT HYDROELECTRIC DAM).

PARISH OF EAST BATON ROUGE $\overline{\nu}$ BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION). W69-08324

FENCING WATER-WAYS. W69-08362 06E

PUBLIC SERVICE COMPANIES. W69-08369

CAPE COD CANAL (MASS)
LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS
ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL,
05C

CARBON AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS, W69-08278

ALGAE AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS, W69-08278 CARBON CYCLE

AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS, W69-08278

CENOZOIC ERA
SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS IN KANSAS, 02F

SEASONAL VARIATION IN ALKALINITY IN PANS IN CENTRAL APRICA, W69-08301

CFSIUM
AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM, ¥69-08271

CESIUM~137 ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM, W69-08271

CHANNEL IMPROVEMENT PUND FOR MATERWAY IMPROVEMENT PROJECTS IN CHARLES COUNTY BUILDING ACROSS NAVIGABLE RIVER PROBIBITED. 869-08331

CHAPARRAL REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING OF OAK-MOUNTAINMAHOGANY CHAPARRAL,

SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, 869-08474

BURNED CHAPARRAL TO GRASS BARLY EFFECTS ON WATER AND SEDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN ARIZONA.

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES, W69-08488

CHAPARRAL WATERSHEDS
GAZING IN RELATION TO BUNOFF AND EROSION ON SOME CHAPARRAL
WATERSHEDS OF CENTRAL ARIZONA,

CHEMICAL ANALYSIS
A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.
W69-08199
05D

STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRANFORD, W69-08521

DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRATION, 969-08559 05A

CHEMICAL PRECIPITATION SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION THEIR INFLICATION ON DIAGENESIS, W69-08218

CHEMICAL PROPERTIES WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG, W69-08455

CHEROKEE COUNTY
LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT STREAMS. W69-08159

CHESAPEAKE BAY
OBSERVATIONS OF HOTION AT INTERMEDIATE AND LARGE SCALES IN A
COASTAL PLAIN ESTUARY,
#69-08598 02L

CHESTER COUNTY

LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT STREAMS. W69-08159 . 06E

PALEOLIMNETIC SALINITY OF DZUNGAR AND ORDOS BASINS, W69-08594 02H

CHROMIUM TRANSPER OF ZN-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN, $\%69{-}08273$

LOCAL PROVISIONS. W69-08155

0 5 G

CAPITAL CANDY CO INC V CITY OF MONTPELIER (FLOOD DAMAGE PROM DRAINAGE SYSTEM).
W69-08170 06E

BROWN V CITY OF JOLIET. W69-08177

#09-00177

PUBLIC WORKS AUTHORIZED UNDER ARTICLE. W69-08179

FENCING WATER-WAYS.

W69-08362 06

CLAMS

CONSERVATION.

W69-08163 06E

CLASSIFICATION CLASSIFICATION OF WATERS AND STANDARDS OF PURITY. W69-08353 $\,$ 05F

CLEAR-CUTTING
WATER YIELD CHANGES AFTER CONVERTING A FORESTED CATCHMENT TO
GRASS,
M69-08200

CLIMATIC ZONES
POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN
WESTERN STATES WITH EMPHASIS ON CALIFORNIA,
W69-08308
02D

CLIMATOLOGY GEOMORPHOLOGY, W69-08226

0.28

SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW COVER, M69-08451 02C

CLOSED CONDUIT FLOW UNSTEADY FLOW IN A RESERVOIR-CONDUIT SYSTEM, W69-08202 088

COAGULATION
RESEARCH ON TREATMENT OF DYE WASTES,
M69-08558 05D

COAL PRODUCTS AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATHENT OF HIME DRAINAGE WATERS, W69-08466 05D

COASTS
DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND HONROVIA (PRENCH), W69-08255

COBALT

ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON,

05C

COBALT RADIOISOTOPES

ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE
ZOOPLANKTON,
#69-08523

O5C

COMESSION

PROOTBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS RPLATED TO SOIL FORMING PACTORS,

W69-08482

02J

SURPACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-MEYADA FOREST SITES, W69-08513

COHO SALHON
EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-WATER FISHES,
#69-08516 05C

COLD REGIONS
SNOW ACCUMULATION ON BOUNT LOGAN, TUKON TERRITORY, CANADA.
169-08207 02C

PRECIPITATION IN MORTHERN QUEBEC AND LABRADOR AND EVALUATION OF MEASUREMENT TECHNIQUES, W69-08587 02B

COLD WATER FISH EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-

WATER FISHES, W69-08516

05C

COLIFORMS
WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG, M69-08455 05B

BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, W69-08563 05B

COLORADO
GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY
HOLE, GARPIFLD COUNTY, COLORADO,
W69-08596 02P

COLORADO-BIG THOMPSON PROJECT
WINDPALL GAINS PROM TRANSPER OF WATER ALLOTMENTS WITHIN THE
COLORADO-BIG THOMPSON PROJECT,
W69-08385
068

COMMERCIAL FISHING
POSSESSION OF CERTAIN MARINE LIFE.
W69-08164 06E

COMMERCIAL SHELLFISH
TAKING OYSTERS FROM CERTAIN WATERS.
W69-08162
06

COMPENSATION
RIVER AND HARBOR IMPROVEMENT.
W69-08128

ARKANSAS STATE HIGHWAY COMM V CARRUTHERS (DAMAGES IN EMINENT DOMAIN PROCEEDING). $$\rm M69{-}08184$

COMPUTER MODELS
A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EPPECTIVENESS IN SOLVING RUNOFF ANALYSIS, W69-08230 02A

SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS, w69-08232

OPERATIONAL STREAMPLOW FORECASTING WITH THE SSARR MODEL, $\ensuremath{\text{W69-08245}}$

APPLICATION OF STREAMPLOW SYNTHESIS AND RESERVOIR REGULATION -- SSARM'--PROGRAM TO THE LOWER MERONG RIVER, W69-08246 02E

COMPUTER PROGRAMS
APPLICATIONS OF COMPUTER TECHNOLOGY TO HYDROLOGIC MODEL
BUILDING,
W69-08237
07C

A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULARE VOLUMES OF PRECIPITATION, #69-08238 07C

HYPOTHETICAL PLOOD COMPUTATION FOR A STREAM SYSTEM, W69-08239 07C

OPERATIONAL STREAMPLOW FORECASTING WITH THE SSARR MODEL, W69-08245

APPLICATION OF STREAMPLOW SYNTHESIS AND RESERVOIR REGULATION -*SSARR*--PROGRAM TO THE LOWER BEKONG RIVER, w69-0824 02E

LAG TIME OF NATURAL CATCHMENTS, W69-08250 02

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, W69-08543

OPTIMAL IDENTIFICATION OF LUMPED WATERSHED MODELS, #69-08570 02A

CONCENTRATION
THE CONCENTRATION OF ZW-65 BY OYSTERS MAINTAINED IN THE
DISCHARGE CANAL OF A NUCLEAR POWER PLANT,
W69-08268
05C

CONCENTRATIONS IMPLUENCE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF ZN-65 BY AN EXPERIMENTAL COMMUNITY, $$\rm w69{+}08267$

CONDEMNATION
RIVER AND HARBOR IMPROVEMENT.
W69-08128

CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDEMNATION VALUE OF ACCRETED LAND). 06E

WATERS AND WATERCOURSES NORTH CAROLINA LINE TO WINYAH BAY. W69-08157

SAVANNAH RIVER WAVIGATION COMMISSION. W69-08160

WATER-PROBT INPROVEMENTS.

06E

STATE V CORE BANKS CLUB PROPERTIES INC (CONDEMNATION OF LAND FOR USE AS NATIONAL PARK). W69-08189 06E

CAMPBELL V STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDENNATION OF A SPRING AND AN EASEMENT).

STATE EX REL TETER V STATE ROAD COMMISSION (DAMAGE ASCERTAINMENT). W69-08375

CONDEMNATION VALUE
RIVER AND HARBOR IMPROVEMENT.
W69-08128 06E

STATE EX REL TFTER V STATE ROAD COMMISSION (DAMAGE ASCERTAINMENT). W69-08375

HEAT BUDGET OF AN ICE COVERED INLAND LAKE, 969-08404 02H

CONIFFROUS FORESTS
FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN, W69-08437

CONIPEROUS TREES
SNOW CATCH BY CONIPER CROWNS, W69-08436

0.20 CONNECTICUT INTERSTATE WATER COMPACT. W69-08325

STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRANFORD, 0.2H

GAME AND FISH. W69-08141

06E

04 A

POSSESSION AND TRANSPORTATION OF PROTECTED GAME AND FISH.

POWPRS AND DUTIES OF THE COMMISSIONER OF CONSERVATION. W69-08143

POLICE POWER AND DUTIES OF THE COMMISSIONER OF CONSERVATION.

PRELIMINARY PROVISIONS.

W69-08161

PROPAGATION AND CONTROL OF FISH AND WILD ANIMALS.

FISH CONSERVATION RULES AND REGULATIONS W69-08364

CONSTRAINTS
NATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE 06A

CONSTRUCTION CONSTRUCTION OF IMPROVEMENT. W69-08339

CONSUMPTIVE USE SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN

COLORADO, W69-08468 FORESTS -- USERS OF WATER, W69-08512 0.3B

CONTINENTAL SHELP NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA, 969-08249

CONTINENTAL SLOPE NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA, W69-08249

CONTROL STRUCTURES
A MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVAILANCHES, #69-08447 02C

CONVENTIONAL TILLAGE
EPPECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON MOISTURE
USE AND YIELD OF CORN,
W69-08434
021

CONVEYANCE STRUCTURES
A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAM, MEXICO,

COOLING PONDS
THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, W69-08406
05C

CHEMICAL CHANGES IN COOLING WATER TOWERS, W69-08402

ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN,

COOLING TOWERS

WATER USE AND RELATED COSTS WITH COOLING TOWERS,

COOLING WATER CHEMICAL CHANGES IN COOLING WATER TOWERS, W69-08402

AN INVESTIGATION INTO THE EFFECTS OF WARMED WATER FROM MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER, W69-08408

PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS,

CORRECTIVE TREATMENT
PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER SUPPLIES, W69-08282

CORRELATION ANALYSIS
SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS, W69-08591

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMFLOW REGULATION, 07C W69-08612

PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTATIONS OF STREAMFLOW REGULATION, W69-08613

SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC W69-08614

COST SHARING
STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. W69-08338

COSTS
A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EPPLUENT FOR IRRIGATION,
05D

COST-BENEFIT ANALYSIS
THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS, w69-08266
06B

PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS, W69-08459

A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, #69-08542 05 D

THE ECONOMICS OF CLEAN WATER, W69-08548 05F

COVENANTS
GOLDIN V TRUSTRES OF VILLAGE OF ELLENVILLE (INTERPERENCE WITH WATER SUPPLY BY CITY).
W69-08355
04C

CONSERVATION.

EFFECTS OF HURRICANE STORMS ON AGRICULTURE, W69-08568

CRUSTACEANS
METABOLISM OF ZINC-65 IN EUPHAUSIIDS, W69-08276

LAYING OUT, ALTERING AND DISCONTINUING HIGHWAYS. W69-08314

CURRENTS(WATER) TURBULENT BOUYANT JETS INTO STRATIFIED OR FLOWING AMBIENT PLUIDS, W69-08423 05B

RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER FLORIDA KEYS, W69-08577 02L

OBSERVATIONS OF MOTION AT INTERMEDIATE AND LARGE SCALES IN A COASTAL PLAIN ESTUARY, W69-08598

CYCLING NUTRIENTS
THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, W69-08274

ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON, R69-08529

CYTOLOGICAL STUDIES ALGAE AMOUNTS OF DWA AND ORGANIC CARBON IN SINGLE CELLS, #69-08278 02K

DAMS AND FLOWAGE PROCEEDINGS IN COURT. W69-08357 04A

JECT INDEX DAM-DIA

			SUB
	MAGES DAMS AND PLOWAGE PROCEEDINGS IN COURS W69-08357	r. 04 A	
	EFFECTS OF HURRICANE STORMS ON AGRICULT		
A	MS ACQUISITION OF A CEPTAIN DAM AND WATER	RIGHTS.	
	POWERS AND DUTIES OF TOWNS.		
	LUENING V PUBLIC SERVICE COMMISSION (P	D6E ERMIT TO CONSTRUCT	
	HYDROELECTRIC DAM). W69-08319	8C	
	GAINESVILLE STONE CO V PARKER (DAMAGE : CAUSED BY IMPROPER DAM MAINTENANCE). W69-08323	TO LAND BY FLOODING	;
	STATE HIGHWAY DEPARTMENT, COST SHARING W69-08338	IN HIGHWAY PROJECT	S.
	LIMITATION OF HYDRO-ELECTRIC CHARTERS. W69-08344	068	
	PLOWAGE. W69-08354	0 4 A	
	DAMS IN DISREPAIR AND CHANNEL IMPROVEM W69-08361	ENT. 04A	
1	TA COLLECTIONS DATA SYSTEMS AND INFORMATION RETRIEVAL RESOURCES,		3
	W69-08389 WATER LEVELS IN OBSERVATION WELLS IN N	10 EBRASKA1968,	
		02P	. 6.
	MISSOURI RIVER BASIN.	07c	
	HYDROLOGIC DATA SYSTEMSDEVELOPING CO W69-08606	NCEPTS, 07A	
DI	TTA NEEDS IMPORTANT WATERSHED CHARACTERISTICS AF FLOOD PEAKS AND EROSION AND SEDIMENTAT NEEDED FOR PRODUCTION, W69-08508	PECTING WATER YIELION AND THE BASIC	DAT.
D.I	TT PROCESSING		
	THE ASSISTANCE OF DIGITAL COMPUTERS IN AND ITS CONSEQUENCES, #69-08233	O7A	-11
	AN OPERATIONAL SYSTEM FOR COMPUTER PRE RIVER FORECASTS ON THE NORTH COAST OF W69-08243	PARATION OF SHORT-S CALIFORNIA, 02A	r er
	COMPUTATIONAL ANALYSES OF MOISTURE PLU W69-08244	X OVER NORTH AMERIC	CA,
D.	ATA STORAGE AND RETRIEVAL DATA SISTEMS AND INFORMATION RETRIEVAL RESOURCES,	. ADAPTABLE TO WATE	R
	W69-08389	10	
D.	BCISION MAKING REUSE CAN BE CHEAPER THAN DISPOSAL, W69-08260	05D	
	DAMS AND PLOWAGE (ADMINISTRATION, PROC NEW HAMPSHIRE WATER RESOURCES BOARD). W69-08345	CEDURE, AND APPEALS	OF
D	EEDS POWERS OF THE GOVERNOR AND COUNCIL.	•	
	W69-08193 GOLDIW V TRUSTEES OF VILLAGE OF ELLENW WITH WATER SUPPLY BY CITY).		
D	W69-08355 EER	04C	
	IMPROVING WATER YIELD AND GAME HABITAT OF CHAPARRAL, W69-08483	O3B	OL
D	EFINITIONS LAKE TERMINOLOGY WATER BLOOM, W69-08279	05c	
D	ELAWARE PRELIMINARY PROVISIONS. W69-08161	06 B	
	TAKING OYSTERS PROM CERTAIN WATERS. W69-08162	06E	
	CONSERVATION. 869-08163	06E	
	ALLEGA OF CORRESPOND AND AND		

W69-08164

HIGHWAYS (USE OF LANDS UNDER DELAWARE RIVER).

W69-08165 06E CREEKS OR RUNS WIDENING, STRAIGHTENING, ETC. W69-08337 DELAWARE RIVER AND BAY AUTHORITY. w69-08356 06 E REGULATION OF WATER RESOURCES. 044 M69-08360 DELAWARE MEMORIAL BRIDGE
HIGHWAYS (USE OF LANDS UNDER DELAWARE RIVER).
W69-08165 06E DELAWARE RIVER AND BAY AUTHORITY. W69-08356 06E DELAWARE RIVER
HIGHWAYS (USE OF LANDS UNDER DELAWARE RIVER).
W69-08165 06E REGIONAL WATER QUALITY STANDARDS, W69-08213 05G DELAWARE RIVER BASIN COMMISSION REGULATION OF WATER RESOURCES. W69-08360 WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS, DEMONSTRATION WATERSHEDS
THE WORKMAN CREEK EXPERIMENTAL WATERSHED, 869-08473 PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION, W69-08478 DENITRIPICATION TREATMENT OF HIGH NITRATE WATERS, W69-08228 050 DENSITY PROFILES
USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED MANAGEMENT, W69-08496 DENSITY STRATIFICATION
TURBULENT BOUYANT JETS INTO STRATIFIED OR PLOWING AMBIENT PLUIDS, W69-08423 NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS, SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW COVER, W69-08451 USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED MANAGEMENT, W69-08496 DESALINATION
REVERSE OSMOSIS MEMBRANE REGENERATION,
W69-08395 03A MATHEMATICAL HODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION, 03A W69-08549 DESALINATION PLANTS
DESALINATION-POWER PLANT PROVES ECONOMICALLY PEASIBLE, W69-08295 DESALINATION-POWER PLANT
DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE,
W69-08295
03A DESIGN
REVIEW OF SURFACE WATER SYSTEMS AWALYSIS, A PIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, W69-08544 PORECASTS WITH VARYING RELIABILITY, 02E M69-08545 STICK CRITERIA POTENTIAL REUSE OF EPPLUENT AS A FACTOR IN SEWERAGE DESIGN, N69-08262 RECIRCULATION OF COOLING WATER IN RIVERS AND CANALS, STREAMPLOW - AN IMPORTANT FACTOR IN FOREST MANAGEMENT IN THE COASTAL PLAIN, W69-08439 02E AGENESIS
SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF HODERN CARBONATE SEDIMENTATION THEIR IMPLICATION ON DIAGENESIS, W69-08218

SUBJECT INDEX

W69-08396

PRECIPITATION AND LITHIPICATION OF DEEP-SEA CARBONATES IN 0.2,7 DIFFUSION
BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR, 08B ANALYZING STRAM POWER PLANT DISCHARGES, W69-08411 058 DIGESTIVE RATES
DETERMINATION OF PEEDING CHRONOLOGY IN FISHES,
05C DIGITAL COMPUTERS
ON A METHOD OF FLOOD PORECASTING USING A DIGITAL COMPUTER CONNECTED WITH A WEATHER RADAR, 0.23 A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EFFECTIVENESS IN SOLVING RUNOFF ANALYSIS, 02A ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID OF ELECTRONIC COMPUTERS (PRENCH), W69-08231 SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND PLOOD FORECASTING PROBLEMS, 02E THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESPARCH AND ITS CONSEQUENCES, W69-08233 DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SMALL WATERSHED, W69-08234 O7C PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION PROGRAM, 07C APPLICATIONS OF COMPUTER TECHNOLOGY TO HYDROLOGIC MODEL DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, \$69-08242AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM RIVER FORECASTS ON THE NORTH COAST OF CALIFORNIA, W69-08243 028 COMPUTATIONAL ANALYSES OF MOISTURE FLUX OVER NORTH AMERICA, USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES, 869-08624 ANALYSIS A NONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND CANALS, W69-08398 DISCHARGE(WATER)
SOME PROBLEMS OF STREAMFLOW FORECASTS BASED ON INFORMATION THEORY. THE CONCENTRATION OF ZN-65 BY OTSTERS HAINTAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT, W69-08268 DISPERSE DYES
RESEARCH ON TREATMENT OF DYE WASTES, 050 DISPERSION OF SILT PARTICLES IN OPEN CHANNEL PLOW, W69-08592 DISSOLVED OXYGEN
TRANSPER OF OXYGEN IN AQUEOUS SOLUTIONS, W69-08217 EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-WATER FISHES, W69-08516 MATHEMATICAL MODEL FOR DISSOLVED OXYGEN, WATER QUALITY HANAGEMENT IN VIRGINIA, 05G DISTRIBUTION

DISTRICT OF COLUMBIA FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT NO 1, REQUIREMENTS AND SOURCES, 06D LAYING OUT, ALTERING AND DISCONTINUING HIGHWAYS. ROAD CONSTRUCTION. OAC W69-08438 TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS W69-08576 DIURNAL PERIODICITY
FOOD HABITS OF THE YELLOW BASS, ROCCUS MISSISSIPPIENSIS,
CLEAR LAKE, IOWA, SUMMER 1962,
M69-08515
05C DIVERSION BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMM'N (WATER DAMAGE PROM DIVERSION). W69-08311 DIVERSION LOSSES
HACKENSACK WATER COMPANY V VILLAGE OF NYACK (ACTION TO RECOVER FOR WITHDRAWAL LOSS). W69-08312 04C DOCKS
TRESPASSING ON PRIVATE DOCKS. 06E W69-08183 MISCELLANEOUS PROVISIONS (UNLAWFUL DISCHARGE OF OIL IN CHARLESTON HARBOR). W69-08373 DOMESTIC WATER STATE BOARD OF HEALTH WATER. W69-08166 WATERSHED PROTECTION AND PLOOD PREVENTION. PARISH OF EAST BATON ROUGE V BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION). W69-08324 CONSTRUCTION OF IMPROVEMENT. OUA POREST SITE AMELIORATION IN THE COASTAL PLATWOODS OF MISSISSIPPI, #69-08397 POREST DRAINAGE RESEARCH IN THE COASTAL PLAIN, DRAINAGE, W69-08438 SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, W69-08441 04A WIND DAMAGES IMPROPERLY PLANTED SLASH PINE, W69-08442 DRAINAGE DISTRICTS DRAINAGE DISTRICTS UNDER 1911 ACT. w69-08152 PRELIMINARY PROVISIONS. 06 E PROCEDURE TO ESTABLISH DISTRICTS. 04 A DRAINAGE PATTERNS(GEOLOGIC)
THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON NETS
OF VARIOUS ORDERS, RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE NETWORKS, W69-08571 02E DRAINAGE SYSTEMS
CONSTRUCTION AND REPAIR OF BRIDGES AND DRAINAGE SYSTEMS. W69-08320 TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO PULL DITCH DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENTWETOK AND BIKINI ATOLS, 'AUGUST 1964, DRAINS, W69-08576 DREDGING EXCAVATING AND DREDGING IN PUBLIC WATERS. W69-08342 W69-08343 04 A

A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO,

DISTRIBUTION PATTERNS
A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION, M69-08238

SUBJECT INDEX DRO-EST

DROUGHT RPSISTANCE WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS, W69-08303 DYETNG WASTES RESEARCH ON TREATMENT OF DIE WASTES, W69-08558 DYNAMIC PROGRAMMING CHINKING UP SOME CPACKS, M69-08539 OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, #69-08546 MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPPIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION, M69-08549 CAMPBELL V STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDEMNATION OF A SPRING AND AN EASEMENT). GUESS V AZAR (RIGHT OF WAY ACROSS PRIVATE PROPERTY). ECHINODERMS
ZINC-65 IN ECHINODERMS AND SEDIMENTS IN THE MARINE
ENVIRONMENT OFF OREGON,
05C AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIPER, RIVPR, W69-08399 SHRUB SEEDLING REGENERATION APTER CONTROLLED BURNING AND HERBICIDAL TREATHENT OF DENSE PRINGLE MANZANITA CHAPARRAL, W69-08471

ECONOMIC JUSTIFICATION REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION, W69-08391

ECONOMICS

PUTURE ECONOMICS RESEARCH ON WESTERN WATER RESOURCES -- WITH

PARTICULAR REPERENCE TO CALIFORNIA,

06B

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, $869\!-\!08543$

OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, 869-08587

THE ECONOMICS OF CLEAN WATER,

05P

THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A PLANT SITE, W69-08553

ELECTRIC POWER GENERATION THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS, #69-08405

PLECTRIC POWER PRODUCTION
DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, W69-08295

ELIMINATION RATES
ELIMINATION OF IODINE, COBALT, IROW, AND ZINC BY MABINE
ZOOPLANKTON, ₽69-08523

EMINENT DONAIN ABKANSAS STATE HIGHWAY COMM V CARRUTHERS (DAMAGES IN EMINENT DOMAIN PROCEEDING). W69-08184

PROTECTION OF WATER SUPPLY. W69-08195

06 E

PARISH OF EAST BATON ROUGE V BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION). W69-08324

STATE V BENTLEY (WATER DAMAGE). W69-08566 06E

ENERGY BUDGET
PORECASTING HEAT LOSS IN PONDS AND STREAMS,
058

A PRACTICAL PIELD TECHNIQUE FOR MEASURING RESERVOIR

EVAPORATION UTILIZING MASS - TRANSFER THEORY, W69-08418

ENERGY EQUATION ANALYZING STEAM POWER PLANT DISCHALGES, W69-08411 05B

ENIMPTOK ATOLL
DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENIMPTOK
AND BIKINI ATOLS, AUGUST 1964,

ENTRAINMENT ON A MOMERTUM-MASS PLUX DIAGRAM FOR TURBULENT JETS, PLUMES AND WAKES,

DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE, W69-08412

ENVIRONMENT
ZINC-65 IN ECHINODERMS AND SEDIMENTS IN THE MARINE
ENVIRONMENT OFF OREGON,
05C

ENVIRONMENTAL EFFECTS
INFLUENCE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF 2N-65 BY AN EXPERIMENTAL COMMUNITY, W69-08267 05C

ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN,

SNOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND DRY YEARS, $\ensuremath{\text{W6}}\,9{\text{-}}08500$

WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, w69-08504

EQUATIONS
ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL PLOW, W69-08589

EQUILIBRIUM TEMPERATURE
ANALYZING STEAM POWER PLANT DISCHARGES,
058

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS, W69-08417

SUBFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE,

EROSION AND SEDIMENT MOVEMENT POLLONING A WILDPIRE IN A PONDEROSA PINE POREST OF CENTRAL ARIZONA,

GAZING IN RELATION TO RUNOPP AND EROSION ON SOME CHAPARRAL WATERSHEDS OF CENTRAL ARIZONA, M69-08476

ERODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS RPLATED TO SOIL FORMING PACTORS,

W69-08482 SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, W69-08501

SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIZERA-NEVADA FOREST SITES, #69-08513

EROSIONAL CUBRENT MARKS OF WEAKLY COMESIVE MUD BEDS,

EBOSION CONTROL SHORE EROSION CONTROL DISTRICTS. #69-08333

SUMMER DEPERHED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT

DEPERRED GRAZING AND SOIL RIPPING IMPROVES PORAGE ON NEW MEXICO'S RIO PUERCO DRAINAGE, W69-08463

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED, W69-08479

SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION, #69-08502

EROSION AND SEDIMENTATION, W69-08507

PROSION CONTROL DISTRICTS
SHORE PROSION CONTROL DISTRICTS.
W69-08333

040

ESTIMATING EQUATIONS
HULFIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON
USING DATA OP KNOWN PUNCTIONAL RELATIONSHIP,
W69-08499
07B

EST-PEN FSTUARIES OBSERVATIONS OF MOTION AT INTERMEDIATE AND LARGE SCALES IN A COASTAL PLAIN ESTUARY, 02L W69-08598 ESTUARTHE RNVIRONMENT DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND MONROVIA (FRENCH). TRANSPER OF ZN-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN, THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIPLORA IN CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD ESTUARTAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS, W69-08537 021 EUPHAUSIA PACIFICA
METABOLISM OF ZINC-65 IN EUPHAUSITDS, W69-08276 LAKE TERMINOLOGY WATER BLOOM, W69-08279 THE 'WORKING' OF THE MADISON LAKES, 02H W69-08283 EUTROPHICATION, 0.50 MORPHOMETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF LARGE LAKES, STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE PROM LINSLEY POND, NORTH DRANFORD, W69-08521 02H INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT, W69-08503 EVAPORATION SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION THEIR IMPLICATION ON W69-08218 THE USE OF RESERVOIRS AND LAKES POR THE DISSIPATION OF HEAT, W69-08406 A PRACTICAL FIELD TECHNIQUE FOR MEASURING RESERVOIR EVAPORATION UTILIZING MASS - TRANSFER THEORY, 020 020 EVAPORATION CONTROL COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL MOISTURE IN PATER EPPICIENCY STUDIES, W69-08292 02D EVAPOTRANSPIRATION AT A WYOMING MOUNTAIN BOG, W69-08458 EVAPOTRANSPIRATION
POTENTIAL EVAPOTRANSPIRATION IN HUMID AND ARID CLIMATES,
W69-08310
02D WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, EVAPOTRANSPIRATION BY IRRIGATED CORN, HYDROLOGY OF WETLAND FOREST WATERSHEDS, EVAPOTRANSPIRATION AT A WYOMING MOUNTAIN BOG, SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGF FISH WITE 2, 4-W69-08460 SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN COLORADO WATERSHED TREATHENT EFFECTS ON EVAPOTRANSPIRATION. WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, W69-08490 FORESTS -- USERS OF WATER, W69-08512

EVEN AGED FOREST MANAGEMENT PRELITINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE CREEK, ARIZONA WATERSHEDS, #69-08472 03R ARKANSAS STATE HIGHWAY COMM V CARRUTHERS (DAMAGES IN EMINENT DOMAIN PROCEEDING).
W69-08184 EXCAVATION EXCAVATING AND DREDGING IN PUBLIC WATERS. W69-08342 TIDAL WATERS. W69-08343 044 EXPERIMENTAL WATERSHEDS
OBSERVATIONS OF SNOWPACK ACCUMULATION, MELT, AND RUNOFF OW A SMALL ARIZONA WATERSHED, OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEMONSTRATION CUTTINGS OF PONDEROSA FINE IN CENTRAL ARIZONA, POSSIBILITIES OF INCREASING STREAMFLOW FROM FOREST AND RANGE WATERSHEDS BY MANIPULATING THE VEGETATIVE COVER-THE BEAVER CREEK PILOT WATERSHED EVALUATION STUDY, 03B POLLUTION, POISONING, ETC., OF STREAMS DYNAMITING. GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE HOLLUSCS FROM THE LOWER TREMT AND NEUSE RIVERS, 05C W69-08527 PAR WESTERN STATES
POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN
WESTERN STATES WITH EMPHASIS ON CALIFORNIA,
W69-08308
02D PEDERAL GOVERNMENT WATER POLLUTION CONTROL. W69-08127 05 G RELATIONS WITH FEDERAL GOVERNMENT CERTAIN STATE-OWNED W69-08175 06E INTERFERENCE WITH NAVIGATION, ETC. 069-08372PEDERAL JURISDICTION
STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC).
W69-08316
05G UNITED STATES V LOUISIANA (SUIT BY FEDERAL GOVERNMENT AGAINST STATE TO DETERMINE CONTROL OF AREA OUTSIDE 3 MILE BELT). W69-08597 PEDERAL WATER POLLUTION CONTROL ACT
POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA.
W69-08358 05G FEDERAL-STATE WATER RIGHTS CONFLICTS
UNITED STATES V STATE OF LOUISIANA (LOUISIANA BOUNDARY CASE). W69-08134 LIGHTHOUSES AND OTHER AIDS TO NAVIGATION. UNITED STATES V LOUISIANA (SUIT BY PEDERAL GOVERNMENT AGAINST STATE TO DETERMINE CONTROL OF AREA OUTSIDE 3 MILE BELT). W69-08597 FEEDING RATES
INPLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN
METABOLISM OF BLUEGILL SUNFISH, W69-08520 05c LEGAL PENCES WATERS, WHEN NOT SUFFICIENT PENCE. W69-08363 FENCE VIEWERS RIVERS AND STREAMS AS LAWFUL FENCES. W69-08328 06 E FENCING WATER-WAYS. W69-08362 06 E LEGAL FENCES WATERS, WHEN NOT SUFFICIENT FENCE. W69-08363 06E OF CHAPARRAL, WIELD AND GAME HABITAT BY CHEMICAL CONTROL OF CHAPARRAL, W69-08483

GRASS, W69-08200

SURFACE RESISTANCE OF CROP CANOPIES, #69-08573

020

03B

EVAPOTRANSPIRATION CONTROL WATER TIELD CHANGES AFTER CONVERTING A FORESTED CATCHMENT TO

PINANCIAL PEASIBILITY
OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES
SYSTEM,
M69-08540
06A

FINLAND
DROUGHTS IN FINNISH WATERCOURSES WITH REFERENCE TO WATER
SUPPLY AND POLLUTION CONTROL (FINNISH),
W69-08254
02E

PISH CONSERVATION
BOARD OF COUNTY COMMISSIONERS V PATE (PORPEITURE OF ILLEGAL
FISHING DEVICES).
W69-08146
06E

SEINES, TRAPS, OBSTRUCTIONS IN STREAMS, ETC GENERALLY. W69-08173

PISH CONSERVATION RULES AND REGULATIONS. W69-08364

PISH FOOD ORGANISMS
DETERMINATION OF PREDING CHRONOLOGY IN PISHES,
#69-08514
05C

POOD HABITS OF THE YELLOW BASS, ROCCUS MISSISSIPPIENSIS, CLEAR LAKE, IOWA, SUMMER 1962, W69-08515 05C

FISH MANAGEMENT
POSSESSION OF CERTAIN MARINE LIPE.
#69-08164

FISH MIGRATION SEIMES, TRAPS, OBSTRUCTIONS IN STREAMS, FTC GENERALLY. W69-08173 06E

PISH POPULATIONS
PRODUCTION OF JUVENILE STEELHFAD TROUT IN A PRESHWATER IMPOUNDMENT,
169-06517
02H

PISH TYPES SPASONS, WATERS, LIMITS. W69-08168

06E

068

PISHING GAME AND FISH. W69-08141

06E

SEASONS, WATERS, LIMITS. W69-08168

SEINES, TRAPS, OBSTRUCTIONS IN STREAMS, ETC GENERALLY. $w69\!-\!08173$

WILDLIFE MANAGEMENT. W69-08326

06 E

06E

PISHING DEVICES
BOARD OF COUNTY COMMISSIONERS V PATE (FORFEITURE OF ILLEGAL PISHING DEVICES).
W69-08146 06E

FLOOD CONTROL
PLOOD CONTROL AND SOIL CONSERVATION.
W69-08130
ONA

REFORESTATION, AFFORESTATION AND FLOOD CONTROL PROJECTS. W69-08139 06E

WATERSHED PROTECTION AND FLOOD PREVENTION. 069-08150

POWERS AND DUTIES OF TOWNS. W69-08194

ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND NAVIGATION. #69-08352 04A

MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER,

FLOOD DAMAGE
WESTERN AND ATLANTIC RAILROAD V HASSLER (DAMAGES CAUSED BY
INADEQUATE CULVERT).
WG9-08112

CAPITAL CANDY CO INC V CITY OF HONTPELIER (FLOOD DAMAGE FROM DRAINAGE SYSTEM).
W69-08176 06E

CITY OF LOUISVILLE V LOUISVILLE SEED COMPANY (MUNICIPAL TORT LIABILITY FOR PLOOD DAMAGE). 06E

FLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPER, WYOBING-WOLDHE 1. 049-08224 04A

FLOOD PLAIN INFORMATION OF WORTE FORK OBION RIVER, HOOSIER AND GROVE CREEKS, UNION CITY, TENNESSEE. W69-08247 04A

MICHALKA V GREAT WORTHERN PAPER COMPANY (FLOOD DAMAGE). 044

GAINESVILLE STONP CO V PARKEE (DANAGE TO LAND BY FLOODING CAUSED BY IMPROPER DAM HAINTENANCE).

W69-08323 04A

FLOOD PLAIN INFORMATION NEUSE AND TRENT BIVERS AND JACK SMITH CREEK, NEW BERN, NORTH CAROLINA.
469-08593 044

PLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE MAY COUNTY, NEW JERSEY.

PLOOD PLAIN INFORMATION, UPHAM BROOK, HENRICO, VIRGINIA. W69-08610

PLOOD PUBECASTING
ON A HPTHOD OF PLOOD FORECASTING USING A DIGITAL COMPUTEB CONNECTED WITH A WEATHER RADAR, W69-08229 02A

HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM, W69-08239 07C

PLOOD PLAINS
SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT
RANGES,
W69-08462
04A

PLOOD PROTECTION
PATUXENT RIVER WATERSHED.
W69-08147

W69-08149

06 E

WATERSHED PROTECTION AND FLOOD PREVENTION. W69-08150 04A

PRELIMINARY PROVISIONS. W69-08161 06E

FLOOD ROUTING
SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC
METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS,
w69-08232
02E

PROPAGATION OF PLOOD WAVES IN OPEN CHANNELS, W69-08590 02E

FLOODS
MOHESKY V CITY OF WASHINGTON (FLOOD DAMAGE CAUSED BY STREET IMPROVEMENT).
W69-08188
06E

CITY OF LOUISVILLE V LOUISVILLE SEED COMPANY (MUNICIPAL TORT LIABILITY FOR FLOOD DAMAGE). W69-08190 06E

SMITH Y BOARD OF COUNTY ROAD COUNTSSIONERS OF CHIPPENA COUNTY (FLOOD DAMAGE CAUSED BY ROAD CONSTRUCTION AND ACT OF GOD).

809-08192

06E

FLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPER, WYOHING-WOLUME 1. 049-08224 04A

PLOOD PLAIN INFORMATION OF WORTH FORK OBION RIVER, HOOSIER AND GROVE CREEKS, UNION CITI, TENNESSEE.
04A

PLOOD PLAIN INFORMATION NEUSE AND TRENT RIVERS AND JACK SMITH CREEK, NEW BERR, NORTH CAROLINA. W69-08593 04A

FLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE HAY COUNTY, NEW JERSEY.

PLOOD PLAIN INFORMATION, UPHAN BROOK, HENRICO, VIRGINIA. W69-08610

FLORIDA
BOARD OF COUNTY COMMISSIONERS V PATE (FORFEITURE OF ILLEGAL
PISHING DEVICES).
W69-08146
06E

GUESS V AZAR (RIGHT OF WAY ACROSS PRIVATE PROPERTY). W69-08322 06E

RECEBT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER PLORIDA KEYS, W69-08577 02L

FLOW AUGMENTATION
HORESKY V CITY OF WASHINGTON (FLOOD DAMAGE CAUSED BY STREET IMPROVEMENT).
W69-08188
06E

CREEKS OR RUNS WIDENING, STRAIGHTENING, ETC. W69-08337

FLOW CHARACTERISTICS
BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND
RESERVOIR BEHAVIOR,
W69-08403
08B

FLOW PROFILES

BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR,
W69-08403 . 08B

PLOWAGE BIGHTS SAVANNAH RIVER NAVIGATION COMMISSION.

FLO-GRE

W69-08160 06E

FOAM FRACTIONATION
RESEARCH ON TREATMENT OF DYE WASTES,
W69-08558
0

FOOD CHAINS
TRANSFER OF 2N-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN, 969-08273

THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIFLORA IN CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD CHAINS, 469-08277

POOD HABITS
DETERMINATION OF FEEDING CHRONOLOGY IN FISHES, #69-08514 05C

FOOD HABITS OF THE YELLOW BASS, ROCCUS MISSISSIPPIENSIS, CLEAR LAKE, IOWA, SUMMER 1962, W69-08515 05C

FOOD PROCESSING STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY. W69-09186 06E

PORAGES
SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT
RANGES,
W69-DRU62
048

DEFFERED GRAZING AND SOIL RIPPING IMPROVES PORAGE ON NEW MEXICO'S RIO PUERCO DRAINAGE, W69-08463

FORCED PLUMES
NUMPRICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS,
w69-08424
058

PORECASTING
MULTIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON
USING DATA OF KNOWN PUNCTIONAL RELATIONSHIP,
W69-0849
078

WHEN IS IT SAPE TO EXTEND A PREDICTION EQUATION--AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS, W69-08509 07B

FOREST FLOOR
MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE
PONDEROSA PINE STANDS,
269-09461
02G

FOREST MANAGEMENT REFORESTATION AND PLOOD CONTROL PROJECTS. W69-08139 06E

FOREST SITE AMELIORATION IN THE COASTAL FLATWOODS OF MISSISSIPPI, 469-08397 04A

STREAMFLOW - AN IMPORTANT FACTOR IN FOREST MANAGEMENT IN THE COASTAL PLAIN, W69-08439 022

PRELIMINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE

CREEK, ARIZONA WATERSHEDS, USB UNDER HARVEST ON CAMPOSITION OF THE CONTRACT OF THE CAMPOSITION OF THE CAMPOS

POREST OPENINGS SNOW ACCOMULATION AND MELT IN RELATION TO TERRAIN IN WET AND DRY YEARS,

DRY YEARS, W69-08500 02C

FOREST SOILS

WATER TABLE, SOIL MOISTURE, AND OXIGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND POREST SITES, W69-08443 04A

MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE PONDEROSA PIRE STANDS, W69-08461 02G

SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION, $\ensuremath{\mathsf{W69-08502}}$

PORESTS
REFORESTATION, AFFORESTATION AND PLOOD CONTROL PROJECTS.
169-08139

FORFEITURE
BOARD OF COUNTY COMMISSIONERS V PATE (FORFEITURE OF ILLEGAL PISHING DEVICES).
W69-08146
06E

PRANCE GLACIAL AND FLUVIO-GLACIAL FORMATIONS OF THE LYON REGION (PRENCH), $$\rm W6\,9{-}08627$

FREE SURFACES

BASIC STUDY OF JET FLOW PATTERNS HELATED TO STREAM AND RESERVOIR BEHAVIOR, W69-08403

FROUDE NUMBER
DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE

SURFACE, W69-08412

08

PWPCA AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN. $469-08220 \\ 05C$

GARPIELD COUNTY(COLO)
GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY
HOLE, GARPIELD COUNTY, COLORADO,
W69-08596
02P

GASES
UNDERGROUND GAS STORAGE.
W69-08138
06

GFOCHEMISTRY
INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID
BASIN ARIZONA, U.S.A.,
W69-08300
02F

GEOELECTRICAL PROFILE
THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED PORMATIONS IN SEMI-ARID AREAS,
W69-08297
07B

GEOELECTRICAL SOUNDING
THE APPLICATION OF GEORLECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,

GEOHYDROLOGIC UNITS
GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI
AND LOUISIANA,
M69-08264
02P

GEOMORPHOLOGY GEOMORPHOLOGY, W69-08226 02B

GEORGIA
WESTERN AND ATLANTIC RAILROAD V HASSLER (DAMAGES CAUSED BY INADEQUATE CULVERT).
W69-08132
06E

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN GEORGIA. W69-08225

GAINESVILLE STONE CO V PARKER (DAMAGE TO LAND BY FLOODING CAUSED BY THEROPER DAM MAINTENANCE). W69-0832 3

GRRMINATION INFLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE GRASSES, w69-08467 . 021

GLACIERS
GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL FOR FIELD AND
OFFICE WORK,
W69-08227
02C

GLACIAL AND PLUVIO-GLACIAL FORMATIONS OF THE LYON REGION (FRENCH), 449-08627

GLACIOLOGY
GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL FOR FIELD AND OFFICE WORK, #69-08227

02C

GRAND CANYON
WASTEWATER REUSE AT THE GRAND CANYON,
W69-08290
05D

GRANITIC SOILS
SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE,
ARIZONA,
M69-08474
04D

GRASSLANDS
DETRIMENTAL EFFECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN
WEST-CEPURAL NEW MEXICO,
W69-08464
02G

GRAVELS
A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY
AND SIZE OF GRAVEL PRAGMENTS,
W69-08585
07B

PEBBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAEOCUBRENTS, #69-08608 02J

GRAZING
GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL
WATERSHEDS OF CENTRAL ARIZONA,
W69-08476 04D

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED, $\#69{-}08479$

GREAT LAKES
DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, W69-08242
07C

NATURAL AND POLLUTION SOURCES OF IODINE, BROWINE, AND CHLORINE IN THE GREAT LAKES, W69-08562 05A

W69-08481

SUBJECT INDEX

GREENVILLE FINE SANDY LOAM

EPPRCTS OF SOIL MOISTURE REGIME ON YIELD AND

EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE HEAT BALANCE STUDIES DURING AN ICE-FOG PERIOD IN PAIRBANKS, ALASKA, W69-08198 0.20 SPECIES, W69-08427 HEAT BUDGET HEAT BUDGET OF AN ICE COVERED INLAND LAKE, W69-08404 02H GROUNDWATER AN OUTLINE OF POLAND'S HYDROGRAPHY (POLISH), R69-08253 PORTCASTING HEAT LOSS IN PONDS AND STREAMS, W69-08415 SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS IN KANSAS, W69-08265 ANALYZING STEAM POWER PLANT DISCHARGES, W69-08411 GPOLOGY AND GROUNDWATER OCCURPENCE IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO, W69-08287 02F THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL COMDITIONS, W69-08417 GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, W69-08457 HEATED WATER THERMAL EFFLUENT MAY CUT COST OF SHRIMP COCKTAIL. WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA-- 1968, WARM-WATER IRRIGATION AN ANSWER TO THERMAL POLLUTION, SUGGESTIONS ON COMPILATION OF SMALL SCALE HYDROGEOLOGICAL #69-08561 MAPS, W69-08595 070 HELE-SHAW MODELS AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-08625 WATER RESOURCES AND DEVELOPMENT WATER RESOURCES, W69-08604 02F PRINCIPLES OF HYDROLOGY, W69-08628 02A HERBICIDES IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL GROUNDWATER BASINS
CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN
MANAGEMENT STUDIES, OF CHAPARRAL, EFFECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER QUALITY, W69-08484 PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION PROGRAM, W69-08236 07C HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND BIRCHLEAF MOUNTAINMAHOGANY, 03B GROUNDWATER MOVEMENT
TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH ACID KAOLINITIC SOIL, HERRINGS PRINGS
THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE
ANCHOVY (ANCHOA LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD
HERRING (OPISTHONEMA OGLINUM LASUEUM), AND ALGA (UDOTEA
PLABELLUM LAMOUROUX),
W69-08525 THE CONTROL OF GROUNDWATER OCCURRENCE BY LITHOFACIES IN THE GUADALUPIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO, W69-08294 HIGHWAY CONSTRUCTION
ARKANSAS STATE HIGHWAY COMM V CARRUTHERS (DAMAGES IN EMINENT
DOMAIN PROCEEDING).
W69-08184
06e SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE FLOW PROBLEM, W69-08575 02F THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS, HIGHWAY EFFECTS
MOHESKY V CITY OF WASHINGTON (FLOOD DAMAGE CAUSED BY STREET IMPROVEMENT).

06P. GROWTH RATES
PRODUCTION OF JUVENILE STEELHEAD TROUT IN A FRESHWATER IMPOUNDMENT, SMITH Y BOARD OF COUNTY ROAD COMMISSIONERS OF CHIPPEWA COUNTY (FLOOD DAMAGE CAUSED BY ROAD CONSTRUCTION AND ACT OF GROWTH RESPONSE
FOREST SITE AMELIORATION IN THE COASTAL FLATWOODS OF MISSISSIPPI,
M69-08397
04A GOD). W69-08192 06E HIGHWAYS
SUITS FOR INJURIES ON HIGHWAY.
W69-08171 06 E REGIONAL ECONOMIC DEVELOPMENT AND WATER, W69-08387 MUNICIPAL PUBLIC WORKS. HABITAT IMPROVEMENT KEEP MAINE SCENIC ALLAGASH RIVER AUTHORITY. LAYING OUT, ALTERING AND DISCONTINUING HIGHWAYS. W69-08314 $\,$ W69-08131 ROAD CONSTRUCTION. W69-08365 HAMFORD(WASH)
RADIOZINC DECLINE IN STARRY PLOUNDERS AFTER TEMPORARY
SHUTDOWN OF HAMFORD REACTORS, HISTORICAL WATERS
THE MARITIME BOUNDARIES OF THE STATES,
W69-08329 06E HARBORS AND PUBLIC WATERS. HISTORY OF TECHNOLOGY

A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AHALUCAN, MEXICO, W69-08197 06E M PRECEDO MISCELLANEOUS PROVISIONS (UNLAWPUL DISCHARGE OF OIL IN CHARLESTON HARBOR). M69-08373 HORIZONTAL SURFACE JET DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE, W69-08412 HARDWARE-CLOTH CHECKS
SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, ARIZONA, W69-08474 HUNID AREAS
THE WORKMAN CREEK EXPERIMENTAL WATERSHED, 869-08473 SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS, W69-08622 05D PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION, W69-08478 03B ARANGS
DARS AND PLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE MATER RESOURCES BOARD).

169-08345
043 HUMID CLIMATES
POTENTIAL EVAPOTRANSPIRATION IN HUMID AND ARID CLIMATES, W69-08310 THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL SUSQUEHANNA PLATS.

W69-08492

HURRICANES

869-08417

HEAT BALANCE

13

EFFECTS OF HURRICANE STORMS ON AGRICULTURE, N69-08568

HYBRID COMPUTERS
ON A METHOD OF PLOOD FORECASTING USING A DIGITAL COMPUTER
CONNECTED WITH A WEATHER RADAR,
1502-02129 02A

A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THERE PEPECTIVENESS IN SOLVING RUNOFF ANALYSIS, 02A

PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION PROGRAM, W69-08236 07C

HYDRAULIC CONDUCTIVITY

HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING HOUNTAIN BOG, USG-08456

026

HYDROCARBONS
OLEFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,
M69-08284
05A

HYDRODYNAMICS
ESTURRIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY
CONSIDERATIONS,
W69-08537
02L

HYDROFLECTRIC PLANTS
LUPKING V PUBLIC SERVICE COMMISSION (PERMIT TO CONSTRUCT
HYDROELECTRIC DAM).
M69-08319
8C

LIMITATION OF HYDRO-ELECTRIC CHARTERS. W69-08344

HYDROELECTRIC PROJECT LICENSING
LIMITATION OF HYDRO-ELECTRIC CHARTERS.
W69-08344 06E

HYDROGEN BONDING
OBSERVED DIPPRACTION PATTERN AND PROPOSED MODELS OF LIQUID
WATER,
USB-00560

HYDROGEOLOGY
SUGGESTIONS ON COMPILATION OF SMALL SCALE HYDROGEOLOGICAL MAPS,

GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY HOLE, GARPIELD COUNTY, COLORADO, W69-08596 02P

HYDROLOGIC BUDGET
INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT,
W69-08503 03B

HYDROLOGIC CYCLE
HYDROLOGY OF WETLAND FOREST WATERSHEDS,
W69-08440 04

HYDROLOGIC DATA

THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESEARCH AND ITS CONSEQUENCES, W69-08233 07A

A HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN, W69-08304 $$0.7\,\mathrm{A}$$

AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK DESIGN, 07A

A FIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, 069-08544 06A

SURPACE WATER SUPPLY OF THE UNITED STATES, 1961-65 PART 6. HISSOURI RIVER BASIN. 07C

HYDROLOGIC DATA SYSTEMS--DEVELOPING CONCEPTS, w69-08606

HYDROLOGIC PROPERTIES
DESCRIPTION OF THE HYDROLOGIC REGINE OFF THE GRAIN AND IVORY
COASTS BETWEEN ABIDJAN AND MONROVIA (PRENCH),
W69-08255
02L

HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG , 69-08456

WATPRSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, M69-08504

IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD, FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION,

RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND FERN-COVERED AND BURNED WATERSHEDS IN HAWAII, W69-08510 02G

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, 69-08543

HYDROLOGY

PRINCIPLES OF HYDROLOGY,

02A

HYDROSTATIC PRESSURE

EPPECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS
IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC
WATER POTENTIAL DIFFERENCES BETWEEN ROOT LYLEM AND EXTERNAL
MEDIUM,
669-08291

021

HYGROMETRY
ATMOSPHERIC HUMIDITY MEASUREMENT NEAR THE SNOW SURFACE,
W69-08452
02C

ICE BREAKUP
ANDUTO V VILLAGE OF HERKIMER (MUNICIPAL LIABILITY FOR
BLASTING CAUSING PLOOD DAMAGE).
W69-08368
06E

ICE POG
HEAT BALANCE STUDIES DURING AN ICE-POG PERIOD IN FAIRBANKS,
ALASKA,
M69-08198

ICE JAMS
MICHALKA V GREAT NORTHERN PAPER COMPANY (FLOOD DAMAGE).
M69-08318

ICE-PREE REACHES
THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS, W69-08422 05C

ICTALURUS MELAS
DETERMINATION OF FEEDING CHRONOLOGY IN FISHES,
W69-08514
05C

IDAHO
SNOW CATCH BY CONIFER CROWNS,
W69-08436
02

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN IDAHO.
W69-08601 08A

ILLINOIS

HETROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED

STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION).

W69-08172

05G

BROWN V CITY OF JOLIET. W69-08177 061

IMPOUNDED WATERS
PRODUCTION OF JUVENILE STEELHEAD TROUT IM A PRESHWATER
IMPOUNDMENT,

INDIANA
WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF
ENGINEERS IN INDIANA.
W69-08603
08A

INDUSTRIAL WATER STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY. W69-08186

INFILTRATION
THE VERTICAL MOVEMENT OF WATER IN STRATIFIED POROUS
MATERIAL. 2. TRANSIENT STAGES OF DRAINAGE TO A WATER
TABLE,
M69-08203
02G

EFFECT OF GRAZING ON INPILTRATION IN A WESTERN WATERSHED, W69-08479 $$\rm 04D$

INFILTROMETERS
EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED, W69-08479

04D

INFORMATION RETRIEVAL
DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER
RESOURCES,
W69-08389

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SMALL GROUPS OR INDIVIDUALS, W69-08511 07C

INJUNCTIONS

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED
STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION).

W69-08172

05G

INLAND WATERWAYS
WATERS AND WATERCOURSES NORTH CAROLINA LINE TO WINIAH BAY.
W69-08157
06E

INSHORE PAUNA
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC
POPULATIONS,
w69-08528
O5C

A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR HEASURING SNOWPACK TEMPERATURES, 469-08469 07B

AN INEXPENSIVE RECORDING SETTLING TUBE FOR ANALYSIS OF

TNS-KEN

SANDS, W69-08582

07B

CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SETTLING TUBE, #69-08583

A CONTACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTICLES, W69-08584 078

A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL PRAGMENTS, W69-08585 07B

INTERCEPTION
SNOW CATCH BY CONIFER CROWNS, W69-08436

0.20

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, W69-08506

FORESTS -- USERS OF WATER, W69-08512

038

INTERNATIONAL WATERS
THE MARITIME BOUNDARIES OF THE STATES,
W69-08329 06E

INTERSTATE COMMISSIONS
MINNESOTA-WISCONSIN BOUNDARY COMPACT (PURPOSE AND INTENT).
W69-08136
06P

A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-08487 $$0.6\mathrm{B}$$

INTERSTATE COMPACTS
MINNESOTA-WISCONSIN BOUNDARY COMPACT (PURPOSE AND INTENT).
W69-08136
06E

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMPACT. W69-08151 05G

INTERSTATE WATER COMPACT. W69-08325

06E

DELAWARE RIVER AND BAY AUTHORITY.

06 E

06E

A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-08487

INTERSTATE RIVERS
POWERS OF THE GOVERNOR AND COUNCIL.
W69-08193

INVESTMENT
WATER RESOURCE DEVPLOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-08388
068

TODINE

NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES,

W69-08562

05A

IODINE RADIOISOTOPES
ELIMINATION OF IODINE, COBALT, IRON, AMD ZINC BY MARINE
ZOOPLANKTON,
W69-08523
05C

YOMA
POOD HABITS OF THE YELLOW BASS, ROCCUS MISSISSIPPIENSIS,
CLEAR LAKE, IOWA, SUMMER 1962,
M69-08515
05c

TRAO GROUND WATER OF THE WESTERN DESERT IN IRAQ, W69-08298 03C

IRON
ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE ZOOPLANKTON, W69-08523
05C

IRRIGATION WATER CONSERVATION AND IRRIGATION CORPORATION. w69-08129 06E

EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON, W69-08430 02D

warm-water irrigation $% \left(1\right) =0$ an answer to thermal Pollution, w69-08561 $% \left(1\right) =0$

IRBIGATION CANALS
KINGERT V REEVES (EASEMENT FOR IBRIGATION CANAL).
W69-08538
06F

IRRIGATION EPFECTS
WATER ECOMONY OF AGAVE, SISALANA OWDER DESERT CONDITIONS, 869-08303
03F

IRRIGATION EPPICIENCY STONATAL IMPILITATION MEASUREMENTS AS AM INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON, W69-08293

IRRIGATION WATER
MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION.

W69-08615 05D

SOIL RESPONSE TO SEWAGE EFFLUENT IRRIGATION, #69-08616

CROP RESPONSE TO SEWAGE EFFLUENT, w69-08617

05D

SALT BUILD-UP PROM SEWAGE EPFLUENT IRRIGATION, W69-08618

PRACTICAL IRRIGATION WITH SEWAGE EPFLUENT, W69-08619 05D

SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS, W69-08622

A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION, $869\!-\!08623$

AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-0862 05D

ISOHYETS
A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION, W69-08238 07C

ISRAEL
A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING,
W69-08251
06A

AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, $969\!-\!08256$

ITALY
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE,
M69-08258 02J

JAPAN
ON A METHOD OF FLOOD FORECASTING USING A DIGITAL COMPUTER
CONNECTED WITH A WEATHER RADAR,
W69-08229
02A

A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EFFECTIVENESS IN SOLVING RUNOFF ANALYSIS, 02A

GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESE), W69-08248 02F

JPTS
BASIC STUDY OF JET PLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR,
W69-08403
08B

ON A MOMENTUM-MASS FLUX DIAGRAM FOR TURBULENT JETS, PLUMES AND WAKES, W69-084 10 088

DIFFUSION OF WARE WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE,

SURPACE DISCHARGE OF HORIZONTAL WARM-WATER JET, $$\text{W}\,69-084\,21$$

TURBULENT BOUYANT JETS INTO STRATIFIED OR FLOWING AMBIENT FLUIDS, 69-08423

NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS, $\pi 69{-}084\,24$

JUDICIAL DECISIONS
DAMS AND PLOWAGE PROCEEDINGS IN COURT.
W69-08357 . 044

JURISDICTION
LIGHTHOUSES AND OTHER AIDS TO NAVIGATION.
W69-08181 06E

JURISDICTION OVER OPPSHORE WATERS AND SUBMERGED LANDS. W69-08315

KANSAS

PR, NN, NI, CO, SR, LI, ZN, AND SILICA IN STREAMS OF THE

LOWER KANSAS RIVER BASIN,

469-08204

054

SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS IN KANSAS, W69-08265

KANSAS RIVER BASIN
PE, MN, NI, CO, SR, LI, ZN, AND SILICA IN STREAMS OF THE
LOWER KANSAS RIVER BASIN,
W69-08204
05A

KARST GROUNDWATER POTENTIAL OF KARST AQUIPERS IN SAUDI ARABIA, $\ensuremath{\text{W}}69-08296$

KENTUCKY
CITY OF LOUISVILLE W LOUISVILLE SEED COMPANY (MUNICIPAL TORT
LIABILITY FOR FLOOD DAMAGE).

KEN-LOU

W69-08190 06E

LABORATORY TESTS
ERODIBILITY INDICES FOR WILDLAND SOILS OF OARU, HAWAII, AS RELATED TO SOIL FORMING FACTORS,

SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA FOREST SITES. 02G

LAGOONS WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, \$W69--08556\$

HEAT BUDGET OF AN ICE COVERED INLAND LAKE,

LAKE CHAD BASIN
A HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN, W69-08304

LAKE PRIE
CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDEMNATION
VALUE OF ACCRETED LAND).

A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO SEDIMENTS, 02J

LAKE MORPHOLOGY MORPHOMETRY AS A DOMINANT PACTOR IN THE PRODUCTIVITY OF LARGE LAKES,

LAKE ONTARIO
A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT,
QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO
SPECIMENTS, 023

LAKE SUPERIOR APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN.

NITROGEN PIXATION IN SOME ANOXIC LACUSTRINE ENVIRONMENTS, \$\mathbb{W}69-08280\$

MORPHOMETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF LARGE LAKES, W69-08519

STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE FROM LINSLEY POND, MORTH BRANFORD, W69-08521 02H

PALEOLIMNETIC SALINITY OF DZUNGAR AND ORDOS BASINS,

LAND ACQUISITION ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND NAVIGATION. M69-08352

LAND FORMING GEOMORPHOLOGY, W69-08226

02B

PLACING PILL IN PUBLIC WATERS. 048

LAND_MANAGEMENT
PATUXENT RIVER WATERSHED.
W69-08149

06E SOIL CONSERVATION DISTRICTS. #69-08336

DETRIMENTAL EFFECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN WEST-CENTRAL NEW MEXICO, WEST-CENT

06 E

LAND RECLAMATION IMPROVEMENT OF SWAMP LANDS.

068

LAND TENURE IN YORK COUNTY TO CLEAN OUT STREAMS.

TRESPASSING ON PRIVATE DOCKS.

LANDPILLS PLACING PILL IN PUBLIC WATERS. W69-08346

LANDSLIDES SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION, M69-08502 04D

LAW OF THE SEA W OF THE SEA THE MARITIME BOUNDARIES OF THE STATES, 06E

WINDPALL GAINS FROM TRANSPER OF WATER ALLOTMENTS WITHIN THE

COLORADO-BIG THOMPSON PROJECT,

LEGISLATION PUBLIC WORKS AUTHORIZED UNDER ARTICLE.

POWERS AND DUTIES OF CONSERVATION OFFICERS. W69-08327 06E

PEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS, W69-08555

LEPONTS MACROCHIRUS
INFLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN
METABOLISM OF BLUEGILL SUNFISH,

LIGHTHOUSES LIGHTHOUSES AND OTHER AIDS TO NAVIGATION. W69-08181 06E

LIMESTONES CRUSHED LIMESTONE BARRIERS A BASIC THE NEUTRALIZATION OF ACID STREAMS, A BASIC FEASIBILITY STUDY IN W69-08376

RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER FLORIDA KEYS, W69-08577 O2L

LINEAR PROGRAMMING
AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN
OPERATION OF A SYSTEM OF DAMS, W69-08536

OPTIBUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES

MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE SYSTEMS, W69-08541

A FIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, W69-08544 064

LINSLEY POND(CONN)
STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL
ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRANFORD,
02H

LITHIFICATION
SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION THEIR IMPLICATION ON DIAGENESIS, M69-08218

LITHOPACIES THOFACLES IN THE GUADALUPIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO, W69-08294 04B

REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED PALL BURNING OF OAK-MOUNTAINMAHOGANY CHAPARRAL, W69-08470

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,

LITTORAL PROPRIETORSHIP
CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDEMNATION VALUE OF ACCRETED LAND). W69-08140

GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL WATERSHEDS OF CENTRAL ARIZONA, W69-08476

LOCAL GOVERNMENTS PATUXENT RIVER WATERSHED. W69-08148

CITY OF LOUISVILLE V LOUISVILLE SEED COMPANY (MUNICIPAL TORT LIABILITY FOR PLOOD DAMAGE).

W69-08190

POWERS AND DUTIES OF TOWNS. W69-08194

PROTECTION OF WATER SUPPLY. 06 E

CONSTRUCTION AND REPAIR OF BRIDGES AND DRAINAGE SYSTEMS.

SHORE EROSION CONTROL DISTRICTS. W69-08333

JULIIANA
PARISH OF EAST BATON ROUGE V BARBAY (COMPENSATION FOR PROPERTY TAKEN FOR DRAINAGE CANAL CONSTRUCTION).

169-08324

04a

KINGERT V REEVES (EASEMENT FOR IRRIGATION CANAL). W69-08538

	UNITED STATES V LOUISIANA (SUIT BY FAAGAINST STATE TO DETERMINE CONTROL OF BELT). W69-08597	EDERAL GOVERNMENT PAREA OUTSIDE 3 MILE 06E
LU	JBROCK(TEX) PRACTICAL IRRIGATION WITH SEWAGE EFFI W69-08619	UENT, 05D
LU	JMBERING PLOATING TIMBER AND DAMAGE THEREFROM. W69-08341	04C
LY	SIMETERS A SIMPLE SNOWMELT LYSIMETER, W69-08206	02C
	COMPARISON BETWEEN RAIN GAGE AND LYST W69-08208	IMETER MEASUREMENTS. 02B
M A	ADISON(WIS) THE "WORKING" OF THE MADISON LAKES, W69-08283	0 2 H
MA	AINE KEEP MAINE SCENIC ALLAGASH RIVER AU W69-08131	THORITY.
	LAYING OUT, ALTERING AND DISCONTINUING W69-08314	NG HIGHWAYS. 04C
	JURISDICTION OVER OFFSHORE WATERS AND W69-08315	SUBMERGED LANDS.
	MICHALKA V GREAT NORTHERN PAPER COMPA	ANY (FLOOD DAMAGE).
E A	ANGANESE THE POTENTIAL IMPORTANCE OF SPARTINA	ALTERNIFIORA IN
	CONVEYING ZINC, MANGANESE, AND IRON : CHAINS,	INTO ESTUARINE FOOD
M 3	W69-08277 ANZANITA	05C
	SHRUB SEEDLING REGENERATION AFTER COL HERBICIDAL TREATMENT OF DENSE PRINGL W69-08471	
Ħ	APPING A DIGITAL COMPUTER PROGRAM TO PLOT IS	SOHYETAL MAPS AND
	CALCULATE VOLUMES OF PRECIPITATION, W69-08238	07c
	SUGGESTIONS ON COMPILATION OF SMALL :	O7C
15.7	W69-08595 ARGINAL SEAS	
15 1		S, 06E
	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE	06E
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE W69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARINE ANIMALS	06E ADIOACTIVE AND STABLE 05C
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. W69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARINE ANIHALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS R69-08276	06E ADIOACTIVE AND STABLE 05C
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. 169-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, 169-08275 ARINE ANIHALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS	06E ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. W69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R. ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS W69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR BADIONUCLIDES IN A W69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON,	ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE HARINE BENTHIC AMPHIPOD, 05C AND ZINC BY MARINE
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE #69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, #69-08275 ARINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSILDS #69-08276 THE EPFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A #69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, #69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS,
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE #69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, #69-08275 ARINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS #69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR BADIONUCLIDES IN A #69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, #69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN #69-08526	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS, OSC
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. M69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, M69-08275 METABOLISM OF ZINC-65 IN EUPPAUSIIDS M69-08276 THE EPFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF POUR RADIONUCLIDES IN A M69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, M69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN M69-08526 ELIMINATION AND TRANSPORT OF COBALT M69-08529	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS, OSC BY MARINE ZOOPLANKTON, OSC
81	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. W69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS W69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A W69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, W69-08526 PHOSPHORUS TURNOVER BY CORAL REEF AN W69-08526 ELIMINATION AND TRANSPORT OF COBALT	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS, OSC BY MARINE ZOOPLANKTON, OSC
B)	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. #69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, #69-08275 ARINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS #69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A #69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, #69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN #69-08526 ELIMINATION AND TRANSPORT OF COBALT #69-08529 ZINC-65 IN ECHINODERMS AND SEDIMENTS ENVIRONMENT OFF OREGON,	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE HARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC INALS, OSC IN THE MARINE ZOOPLANKTON, OSC IN THE MARINE OSC TYEARS AS A BASIS FOR
n i	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. ### MARITIME BOUNDARIES OF THE STATE. ### ### ACOMPARISON BETWEEN THE UPTAKE OF R. ### ZINC BY A MARINE UNICELLULAR ALGA, ### ### ### WEST ALGA OF THE STATE. ### ### ANIHALS ### METABOLISM OF ZINC-65 IN EUPPAUSILDS ### ### ### ### ### ### ### ### ### #	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS, OSC BY MARINE ZOOPLANKTON, OSC IN THE MARINE OSC T YEARS AS A BASIS FOR N,
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. ### MARITIME BOUNDARIES OF THE STATE. #### ### MARITIME BOUNDARIES OF THE STATE. #### ### MARITIME BOUNDARIES OF THE STATE. #### ### MARITIME UNICELLULAR ALGA, #### ### MARITIME UNICELLULAR ALGA, #### ### MARITIME UNICELLULAR ALGA, ### ### ### MARITIME UNICELLULAR ALGA, ### ### ### ### MARITIME UNICELLULAR ALGA, ### ### ### ### ### ### ### ### ### #	OGE ADIOACTIVE AND STABLE OSC OSC AND FEEDING ON THE MARINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC IMALS, OSC BY MARINE ZOOPLANKTON, OSC IN THE MARINE OSC T YEARS AS A BASIS FOR N,
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. W69-08329 ARRINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARRINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSIIDS W69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A W69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, W69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN W69-08526 ELIMINATION AND TRANSPORT OF COBALT W69-08529 ZINC-65 IN ECHINODERMS AND SEDIMENTS ENVIRONMENT OFF OREGON, W69-08531 ARROV PROCESSES PATTERNS OF SUCCESSION OF DRY AND WE COMPUTATIONS OF STREAMFLOW REGULATIO W69-08613 ARRINE MEDIAN OF CERTAIN MARINE LIPE.	ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE HARINE BENTHIC AMPHIPOD, 05C AND ZINC BY MARINE 05C 1MALS, 05C IN THE MARINE ZOOPLANKTON, 05C IN THE MARINE 05C T YEARS AS A BASIS FOR N, 07C
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. ### MARITIME BOUNDARIES OF THE STATE. #### ### ACOMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, #### ### ### ### ### ### ### ### ###	OSC OSC ADIOACTIVE AND STABLE OSC AND FEEDING ON THE MARRINE BENTHIC AMPHIPOD, OSC AND ZINC BY MARINE OSC WHALS, OSC BY MARINE ZOOPLANKTON, OSC IN THE MARINE OSC T YEARS AS A BASIS FOR N, OTC
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. ### MARITIME BOUNDARIES OF THE STATE. ### MARITIME BOUNDARIES OF THE STATE. ### A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, #### W69-08275 ARINE ANIMALS ### METABOLISM OF ZINC-65 IN EUPPAUSILDS ### M69-08276 THE EPPECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A ### M69-08522 ELIMINATION OF IODINE, COBALT, IRON, ### ZOOPLANKTON, ### M69-08526 ELIMINATION OF IODINE, COBALT, IRON, ### M69-08526 ELIMINATION AND TRANSPORT OF COBALT ### M69-08521 ARROV PROCESSES PATTERNS OF SUCCESSION OF DRY AND WE COMPUTATIONS OF STREAMFLOW REGULATION ### M69-08613 ARRIAND ### PATURENT RIVER WATERSHED. ### M69-08197	ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE MARRINE BENTHIC AMPHIPOD, 05C AND ZINC BY MARINE 05C BY MARINE ZOOPLANKTON, 05C IN THE MARINE 05C T YEARS AS A BASIS FOR N, 07C 06E
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. M69-08329 ARINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, M69-08275 METABOLISM OF ZINC-65 IN EUPPAUSIIDS R69-08276 THE PFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF POUR BADIONUCLIDES IN A M69-08522 ELIMINATION OF IODINE, COBALT, IRON, 200PLANKTON, M69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN M69-08526 ELIMINATION AND TRANSPORT OF COBALT M69-08529 ZINC-65 IN ECHINODERHS AND SEDIMENTS ENVIRONMENT OFF GREGON, M69-08531 ARKOV PROCESSES PATTERNS OF SUCCESSION OF DRY AND WE COMPUTATIONS OF STREAMFLOW REGULATION M69-08613 ARLIN POSSESSION OF CERTAIN MARINE LIPE. M69-08149 M69-08149 POWER TO CROSS BOADS, RIGHWAYS AND S OR MANIGABLE WATERS.	ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE HARINE BENTHIC AMPHIPOD, 05C AND ZINC BY MARINE 05C IMALS, 05C IN THE MARINE ZOOPLANKTON, 05C IN THE MARINE 05C T YEARS AS A BASIS FOR N, 07C 06E 06E 06E 06E 06E
n n	ARGINAL SEAS THE MARITIME BOUNDARIES OF THE STATE. W69-08329 ARRINE ALGAE A COMPARISON BETWEEN THE UPTAKE OF R ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 ARRINE ANIMALS METABOLISM OF ZINC-65 IN EUPPAUSILDS W69-08276 THE EFFECT OF TEMPERATURE, SEDIMENT, BEHAVIOR OF FOUR RADIONUCLIDES IN A W69-08522 ELIMINATION OF IODINE, COBALT, IRON, ZOOPLANKTON, W69-08523 PHOSPHORUS TURNOVER BY CORAL REEF AN W69-08526 ELIMINATION AND TRANSPORT OF COBALT W69-08529 ZINC-65 IN ECHINODERMS AND SEDIMENTS ENVIRONMENT OFF OREGON, W69-08531 ARROV PROCESSES PATTERNS OF SUCCESSION OF DRY AND WE COMPUTATIONS OF STREAMFLOW REGULATIO W69-0813 ABELIM POSSESSION OF CERTAIN MARINE LIFE. W69-08164 ARRYLAND RATUARNT RIVER WATERSHED. W69-08149 POWER TO CROSS BOADS, HIGHWAYS AND S	ADIOACTIVE AND STABLE 05C 05C AND FEEDING ON THE HARINE BENTHIC AMPHIPOD, 05C AND ZINC BY MARINE 05C IMALS, 05C BY MARINE ZOOPLANKTON, 05C IN THE MARINE 05C T YEARS AS A BASIS FOR N, 07C 06E 06E 06E 06E 06E 06E 06E

EX	LOU-MAT
BUILDING ACROSS NAVIGABLE RIVER PROHITME9-08331	BITED. 06 E
PUBLIC LANDINGS. W69-08332	06E
SHORE PROSION CONTROL DISTRICTS. W69-08333	04 D
CONSERVATION OF WATER. W69-08334	04 A
NATURAL RESOURCES. W69-08335	06E
SOIL CONSERVATION DISTRICTS. W69-08336	04D
SUSQUEHANNA FLATS. #69-08492	06E
MASS TRANSPER A PRACTICAL FIELD TECHNIQUE POR MEASU EVAPORATION UTILIZING MASS — TRANSPER W69-08418	
MASS WASTING SOIL SLIPS RELATED TO VEGETATION, TOP-SOUTHERN CALIFORNIA, W69-08201	OGRAPHY, AND SOIL IN
MATHEMATICAL MODEL ANALYZING STEAM POWER PLANT DISCHARGE: W69-08411	S, 05B
THE RESPONSE OF WATER TEMPERATURES TO CONDITIONS,	
W69-08417 MATHEMATICAL MODELS	01A
ON THE SOLUTION OF THE PROBLEMS OF IN. OF ELECTRONIC COMPUTERS (PRENCH), w69-08231	FILTRATION WITH THE AID 02G
SOME REMARKS ON THE USE OF DIGITAL COMETHODS FOR FLOOD ROUTING AND FLOOD FW69-08232	
CALIFORNIA'S DIGITAL COMPUTER APPROAC MANAGEMENT STUDIES, W69-08235	H TO GROUNDWATER BASIN
PREPARATION, VERIFICATION AND USE OF SIMULATION PROGRAM, W69-08236	A DIGITAL GROUNDWATER
APPLICATIONS OF COMPUTER TECHNOLOGY TO BUILDING, #69-08237	O HYDROLOGIC MODEL
OPERATIONAL STREAMFLOW FORECASTING WI	TH THE SSARR MODEL,
APPLICATION OF STREAMFLOW SYNTHESIS A - "SSARR"PROGRAM TO THE LOWER MEKONG #69-08246	
LAG TIME OF NATURAL CATCHMENTS,	02E
AN ESTIMATE OF THE RESPONSE RATE OF A W69-08271	
MATHEMATICAL MODEL FOR DISSOLVED OXYG	
W69-08532 OPERATIONS RESEARCH ACTIVITIES AT CIN	
LABORATORY, W69-08534	05D
OPTIMUM OPERATIONS FOR PLANNING OF A SYSTEM, W69-08540	OGA
A TEST OF THE HYPOTHESIS THAT POLLUTI WHAT IT COSTS, W69-08542	ON CONTROL IS WORTH
FORECASTS WITH VARYING RELIABILITY, W69-08545	02E
THE ECONOMICS OF CLEAN WATER, W69-08548	05 P
MATHEMATICAL HODEL AND COMPUTER PROGR OPTIMEM DESIGN OF VERTICAL TUBE EVAPO SALINE WATER CONVERSION, M69-08549	AM POR SIMULATION AND RATION PLANTS FOR 03A
OPTIMAL IDENTIFICATION OF LUMPED WATE W69-08570	RSHED MODELS, 02A
SIMILARITY APPROXIMATION FOR THE RADI PROBLEM, w69-08575	AL SUBSURFACE PLOW
THO-DIMENSIONAL SEEPAGE OF BONDED WAT DRAINS, W69-08576	PER TO FULL DITCH
ONE-DIMENSIONAL EQUATIONS OF OPEN-CHA	NNEL PLOW,

MINERAL LANDS AND LEASES. W69-08145

06 E

MAT-MOL 02E W69-08589 DISPERSION OF SILT PARTICLES IN OPEN CHANNEL PLOW, USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES, 869-08624 MATHEMATICAL STUDIES SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE FLOW W69-08575 MEASUREMENT A CONTACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTICLES, A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL FRAGMENTS, W69-08585 07B PRECIPITATION IN NORTHERN QUEBEC AND LABRADOR EVALUATION OF HEASUREMENT TECHNIQUES, W69-08587 028 MFMBPANE COMPACTION
REVERSE OSMOSIS MEMBRANE REGENERATION,
W69-08395 03A MEMBRANPS
REVERSE OSMOSIS MEMBRANE REGENERATION,
03A TABOLISM
HPTABOLISM OF ZINC-65 IN EUPHAUSIIDS,
05C W69-08276 COMPUTATIONAL ANALYSES OF MOISTURE PLUX OVER NORTH AMERICA, THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM METEOPOLOGICAL EVENTS, W69-08435 DETERBINATION OF PERDING CHRONOLOGY IN FISHES, W69-08514 MEXICO PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO, 69-08396 SMITH V BOARD OF COUNTY ROAD COMMISSIONERS OF CHIPPEWA COUNTY (PLOOD DAMAGE CAUSED BY ROAD CONSTRUCTION AND ACT OF GOD). W69-08192 068 MICROORGANISMS SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE WATER, W69-08400 MIME DRAINAGE WATER
AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, M69-08466 HINE WASTES
BIOLOGICAL OXIDATION RATES IN HINE ACID WATER REGIMES, W69-08379 MINERAL INDUSTRY MINERAL LANDS AND LEASES. #69-08145 06E MINERAL LANDS AND LEASES. W69-08145 06 P. NATURAL RESOURCES. W69-08335 06E MINES AND MINERALS. W69-08371 06E MINNESOTA MINNESOTA-WISCONSIN BOUNDARY COMPACT (PURPOSE AND INTENT). AIRCRAPT UNDERGROUND GAS STORAGE. W69-08137 REPORESTATION, AFFORESTATION AND PLOOD CONTROL PROJECTS. GAME AND FISH. 06 E POSSESSION AND TRANSPORTATION OF PROTECTED GAME AND FISH. POWERS AND DUTIES OF THE COMMISSIONER OF CONSERVATION. W69-08143

POLICE POWER AND DUTIES OF THE COMMISSIONER OF CUMSERVATION.

DIVISION OF PARKS AND RECREATION. W69-08317 CONSTRUCTION AND REPAIR OF BRIDGES AND DRAINAGE SYSTEMS. ¥69-08320 048 STATE V BENTLEY (WATER DAMAGE). W69-08566 06E MISSISSIPPI MISSISSIPPI WATER RESOURCE CONFERENCE -W69-08221 SOME EFFECTS OF PESTICIDES ON MISSISSIPPI WATERS, GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, 05B M69-08563 MISSISSIPPI RIVER
RIVER AND HARBOR IMPROVPMENT.
W69-08128 MISSISSIPPI WATER RESOURCE CONFERENCE . SOME EFFECTS OF PESTICIDES ON MISSISSIPPI WATERS, MOHESKY V CITY OF WASHINGTON (FLOOD DAMAGE CAUSED BY STREET MISSOURI RIVER
SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65
MISSOURI RIVER BASIN.
07C PART 6. MISSOURI RIVEN BASIN SURPACE WATER SUPPLY OF THE UNITED STATES, 1961-65 HISSOURI RIVER BASIN. PART 6. W69-08605 WATER VIELDS RESULTING PROM TREATMENTS APPLIED TO MIXED CONIFER WATERSHED, W69-08477 MIXED PORESTS SURFACE DISCHARGE OF HORIZONTAL WARM-WATER JET, W69-08421 MODEL STUDIES
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE, W69-08258 02J AN APPLICATION OF NON-LINEAR PROGRAMMING TO THE PLANNING OF MUNICIPAL WATER SUPPLY SYSTEMS SOME RESULTS, W69-08535 DISPERSION OF SILT PARTICLES IN OPEN CHANNEL PLOW, MOIST SITE FOREST VEGETATION
WATER YIELDS RESULTING FROM TREATMENTS APPLIED TO MIXED
CONIFER WATERSHED,
W69-08477
03B MOIST SITE TIMBER
THE WORKMAN CREEK EXPERIMENTAL WATERSHED, ₩69-08473 MOISTURE AVAILABILITY
WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY PLANTS, W69-08302 03P MOISTURE DEFICIT
MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE
PONDEROSA PINE STANDS,
02G MOISTURE TENSION
HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, W69-08456 MOISTURE USE PAN EVAPORATION AND NET RADIATION, HOISTURE VARIABLES

EFFECTS OF SOIL MOISTURE REGIME ON YIELD AND

EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE W69-08427 MOLLUSKS ACCUMULATION OF FALLOUT RADIOISOTOPES BY BIVALVE HOLLUSCS FROM THE LOWER TRENT AND NEUSE RIVERS, 469-08527 05C

W69-08144

BJECT INDEX HON-NEW

	3000
MONTE CARLO METHOD CHINKING UP SOME CRACKS, W69-08539	06%
MOUNTAINS SNOW ACCUMULATION ON MOUNT LOGAN, YUKO W69-08207	N TERRITORY, CANADA.
MOLCH TILLAGE EFFECT OF PLASTIC MOLCH, HERBICIDE, AN USE AND YIELD OF CORN, W69-08134	D TILLAGE ON MOISTURE
MULTIPLE PURPOSE RESERVOIRS AN APPLICATION OF LINEAR PROGRAMMING T OPERATION OF A SYSTEM OF DAMS, W69-08536	O EFFICIENCY IN
MULTIPLE-USE MANAGEMENT FORESTS USERS OF WATER, W69-08512	03B
MUNICIPAL TORT LIABILITY CITY OF LOUISVILLE V LOUISVILLE SPED C LIABILITY FOR PLOOD DAMAGE). W69-08190	COMPANY (MUNICIPAL TORT
MUNICIPAL WASTES WATER REUSE IN MONTERREY, MEXICO, W69-08289	05D
MUNICIPAL SEWAGE EPPLUENT FOR IRRIGATI W69-08615	ON. 05D
SALT BUILD-UP FROM SEWAGE EPFLUENT IRR W69-08618	RIGATION, 05D
PRACTICAL IRRIGATION WITH SEWAGE EPPLU W69-08619	DENT, 05D
GROUNDWATER RECHARGE WITH TREATED MUNI W69-08620	CIPAL EPFLUENT, 050
SURVIVAL OF PATHOGENS AND RELATED DISE	PASE HAZARDS,
A TECHNICAL AND ECONOMIC PEASIBILITY S MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATI #69-08623	
MUNICIPAL WATER ROSTON V TOWN OF NEWBURGH (WATER DISTR W69-08367	RICT ASSESSMENT). 06E
AN APPLICATION OF NON-LINEAR PROGRAMMY MUNICIPAL WATER SUPPLY SYSTEMS SOME W69-08535	ING TO THE PLANNING OF RESULTS, 06A
NATIONAL PARKS STATE V CORE BANKS CLUB PROPERTIES INC FOR USE AS NATIONAL PARK). W69-08189	C (CONDEMNATION OF LAND
NATURAL FLOW LANDONNERS IN CHESTER AND CHEROKEE COUSTREAMS.	UNTIES TO CLEAN OUT
W69-08159 / NAVIGABLE RIVERS	06E
SAVANNAH RIVER NAVIGATION COMMISSION. W69-08160	06P
FUND FOR WATERWAY IMPROVEMENT PROJECT: BUILDING ACROSS NAVIGABLE RIVER PROHI W69-08331	S IN CHARLES COUNTY BITED. 06E
NAVIGABLE WATERS CITY OF NEW YORK V BROOKLYN BOROUGH G. RIGHT TO NAVIGABLE STREAM).	AS CO (PUBLIC UTILITIES
W69-08135 MUNICIPAL PUBLIC WORKS. W69-08178	041
WATER-PRONT INPROVEMENTS.	06E
HARBORS AND PUBLIC WATERS.	06E
NAVIGATION SPECIFIC GRANTS OF CESSIONS.	
W69-08182 ACQUISITION OF LAND BY UNITED STATES	OGE FOR FLOOD CONTROL AND
NAVIGATION. W69-08352	04A
INTERPERENCE WITH NAVIGATION, ETC. W69-08372	04 A
THE EFFECTS OF THERMAL POLLUTION ON R W69-08422	IVER ICE CONDITIONS, 05C
NAVIGATION AIDS INTERPERENCE WITH NAVIGATION, ETC. W69-08372	04A
WEBBASKA WATER LEVELS IN OBSERVATION WELLS IN W69-08588	NEBRASKA1968, 02F

ES

NEGLIGENCE
ANNUTTO V VILLAGE OF HERKIMER (MUNICIPAL LIABILITY FOR BLASTING CAUSING FLOOD DAMAGE). NET PRODUCTION
PRODUCTION OF JUVENILE STEELHEAD TROUT IN A PRESHWATER IMPOUNDMENT, MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, W69-08431 MOISTURE USE BY FORAGE SPECIES AS RELATED TO PAN EVAPORATION AND NET RADIATION, W69-08432 NET WATER LOSSES
NET LOSSES IN SPRINKLER IBRIGATION, M69-08305 NETWORKS ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS, NEUSE RIVER(N C)
ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE MOLLUSCS
FROM THE LOWER TRENT AND NEUSE RIVERS,
05C NEUTRALIZATION
CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN
THE NEUTRALIZATION OF ACID STREAMS,
50 AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, W69-08466 NEVADA
AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING
AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES
WITH RECLAIMED WASTEWATER,
W69-08625
05D NEW ENGLAND INTERSTATE WAS COMPACT
NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMPACT.
W69-08151
05G NEW HAAAMPSHIRE PLOOD CONTROL PROJECTS. W69-08167 06E ACQUISITION OF A CERTAIN DAM AND WATER RIGHTS.
W69-08153 OFF SEWAGE DISPOSAL SYSTEMS NEAR SHORELINES. W69-08154 05E POWERS OF THE GOVERNOR AND COUNCIL. W69-08193 06 E POWERS AND DUTIES OF TOWNS. W69-08194 06E PROTECTION OF WATER SUPPLY. 06E W69-08195 IMPROVEMENT OF SWAMP LANDS. 06E HARBORS AND PUBLIC WATERS. W69-08197 06E PRACTICAL ALGAE CONTROL BETHODS FOR NEW HAMPSHIRE WATER W69-08282 PLOATING TIMBER AND DAMAGE THEREPROM. EXCAVATING AND DREDGING IN PUBLIC WATERS. LIMITATION OF HYDRO-ELECTRIC CHARTERS.
06E DAMS AND PLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE WATER RESOURCES BOARD). 044 PLACING FILL IN PUBLIC WATERS. W69-08346 PROTECTING WATER AND ICE SOURCES. #69-08348 ¥69-08349 05G ¥69-08350 05G W69-08351

NEW-OPE ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND W69-08352 W69-08354 DAMS AND PLOWAGE PROCEEDINGS IN COURT. DAMS IN DISREPAIR AND CHANNEL IMPROVEMENT. W69-08361 FENCING WATER-WAYS. LEGAL FENCES WATERS, WHEN NOT SUFFICIENT PENCE. NEW JERSEY
SEWERAGE AUTHORITIES LAW.
W69-08313 DELAWARE RIVER AND BAY AUTHORITY. 06E FLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE MAY COUNTY, NEW W69-08609 GEOLOGY AND GROUNDWATER OCCURRENCE IN SOUTHEASTERN MCKINLEY COUNTY, NEW MEXICO, ¥69-08287 CONTROL OF GROUNDWATER OCCURRENCE BY LITHOPACIES IN THE GUADALUPIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO, W69-08294 W69-08294 PLOOD CONTROL AND SOIL CONSERVATION. CITY OF NEW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES PIGHT TO NAVIGABLE STRFAM). W69-08136 ETKIN V HYNEY (LEGAL CONSTRUCTION OF RESTRICTIVE COVENANT). HACKENSACK WATER COMPANY V VILLAGE OF NYACK (ACTION TO RECOVER FOR WITHDRAWAL LOSS).
W69-08312 04C GOLDIN V TRUSTRES OF VILLAGE OF ELLENVILLE (INTERPERENCE WITH WATER SUPPLY BY CITY). W69-08355 04C KOSTON V TOWN OF NEWBURGH (WATER DISTRICT ASSESSMENT). W69-08367 ANNUTTO V VILLAGE OF HERKIMER (MUNICIPAL LIABILITY POR BLASTING CAUSING PLOOD DAMAGE). REMOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND PORESTLAND, W69-08377 05D NITROGEN COMPOUNDS
DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRATION,
054 NITROGEN FIXATION NITROGEN FIXATION IN SOME ABOXIC LACUSTRINE ENVIRONMENTS, w69-08280

NONMARGINAL PRONOMIC ANALYSIS WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT, W69-08388

NONTIDAL WATERS
MUNICIPAL PUBLIC WORKS.
W69-08178

NON-NAVIGABLE WATERS
BOROUGH OF WINDER V SPADAFORA (CONSTRUCTION EXTENDING INTO NON-NAVIGABLE WATER). W69-08567

NORTH CAROLINA

STATE V CORE BANKS CLUB PROPERTIES INC (CONDEMNATION OF LAND FOR USE AS NATIONAL PARK). W69-08189

BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMMON (WATER DAMAGE FROM DIVERSION). W69-08311

ACCUMULATION OF FALLOUT RADIOISOTOPES BY BIVALVE MOLLUSCS FROM THE LOWER TRENT AND NEUSP RIVERS, $05{\rm C}$

PLOOD PLAIN INFORMATIÔN NEUSE AND TRENT RIVERS AND JACK SMITH CREEK, NEW BERN, NORTH CAROLINA. 04a

NORTH CENTRAL REGION REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,

06B W69-08391 OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES PROBLEMS, W69+08393

NORTH CENTRAL RESEARCH PROJECT NC-57

REGIONAL PESSEARCH IN WATER IN THE NORTH CENTRAL REGION, W69-08391

06B

NUCLEAR POWER PLANTS
CONDITIONS POR COEXISTENCE OF AQUATIC COMMUNITIES WITH THE
EXPANDING NUCLEAR POWER INDUSTRY,
W69-08420
05C

NUCLEAR POWERPLANTS
THE CONCENTRATION OF ZN-65 BY OYSTERS MAINTAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT,
05C

NUCLEAR REACTORS RADIOZINC DECLINE IN STARRY PLOUNDERS AFTER TEMPORARY SHUTDOWN OF HANFORD REACTORS, W69-08270

STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC). W69-08316 $\,$

NUISANCE(PUBLIC)
CITY OF NEW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES
HIGHT TO NAVIGABLE STREAM).
M69-08135
06E

NUTRIENT UPTAKE
EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT,
AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES,
02D

NUTRIENTS
PLANT NUTRIENTS IN BASE FLOW OF STREAMS IN SOUTHWESTERN

WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968, W69-08588

OBSTRUCTION TO FLOW LANDOWNERS IN YORK COUNTY TO CLEAN OUT STREAMS. W69-08158

LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT STREAMS. W69-08159 068

ANNUTTO V VILLAGE OF HERKIMER (MUNICIPAL LIABILITY FOR BLASTING CAUSING FLOOD DAMAGE).

OBSTRUCTION TO NAVIGATION CITY OF NEW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES RIGHT TO NAVIGABLE STREAM).
W69-08135

OCEANS NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA, w69-08249 02J

JURISDICTION OVER OFFSHORE WATERS AND SUBMERGED LANDS. W69-08315

ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2-METHYLBORNANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL ACTINOMYCETES. W69-08219 05A

OFFSHORE FAUNA
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS,

05c

CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDENNATION VALUE OF ACCRETED LAND).
W69-08140 06E

OLEPINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE, W69-08284 05A

MORPHONETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF LARGE LAKES, #69-08519

OPEN CHANNEL A NONDIMENSIONAL APPROACH TO THE PLOW OF WATER IN PLUMES AND CAWALS, W69-08398 088

OPEN CHANNEL PLOW ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL PLOW, W69-08589

OPE-PAR

PROPAGATION OF FLOOD WAVES IN OPEN CHANNELS,

OPERATIONS RESEARCH
APPLICATION OF COMPUTERIZED OPERATIONS RESEARCH TECHNIQUE
FOR OPTIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER

9-08240

OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORATORY, #69-08534 05D

OPISTHONEMA OGLIMUN
THE MATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE ANCHOYY (ANCHOA LAMPROTARNIA HILDEBRAND), ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA FLABELLUM LAMOUROUX), W69-08525

OPTIMIZATION
APPLICATIONS OF COMPUTER TECHNOLOGY TO HYDROLOGIC MODEL
BUILDING,
W69-08237
07C

A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING, 06A

AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, W69-08256

MATHEMATICAL MODEL FOR DISSOLVED OXYGEN, W69-08532 05D

REVIEW OF SURFACE WATER SYSTEMS ANALYSIS, W69-08533

MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE SYSTEMS, #69-08541 06A

A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, W69-08542 05D

ECONOMIC EVALUATION OF RESERVOIR SISTEM ACCOMPLISHMENTS, W69-08543

A FIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, W69-0854 06A

FORECASTS WITH VARYING RELIABILITY,

W69-08545 WITH VARIENG RELIABILITY,

STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, \$69-08546 06A

OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, w69-08547

THE ECONOMICS OF CLEAN WATER, W69-08548

169-08548

MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION, W69-08549 03A

INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, W69-08550 02F

OPTIMUM DEVELOPMENT PLANS
PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS.

M69-08459
03B

OREGON
ZINC-65 IN ECHINODERMS AND SEDIMENTS IN THE MARINE
ENVIRONMENT OFF OREGON,
#69-08531
05C

WATER RESOURCES AND DEVELOPMENT WATER RESOURCES, W69-08604

ORGANIC CARBON
ALGAE AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS,
W69-08278
02K

ORGANIC MATTER
A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT,
QUARTZ AND ORGANIC CARBON IN SOME LAKE ERZE AND LAKE ONTARIO
SEDIMENTS,
M69-08586
02J

ORGANIC SOILS
SOILS IMPORMATION USED AND REEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, 869-08441 04A

ORGANIZATIONS
OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES
PROBLEMS,
W69-08393
06B

OSMOTIC PRESSURE

EPPECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS
IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC
WATER POTENTIAL DIFFERENCES BETWEEN ROOT XYLEM AND EXTERNAL
MEDIUM,
W69-08291

021

OVERLAND PLOW
DEFERRED GRAZING AND SOIL RIPPING IMPROVES FORAGE ON NEW
MEXICO*S RIO PUERCO DRAINAGE,
M69-08463
04A

OWNERSHIP OF BEDS
CITY OF NEW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES RIGHT TO NAVIGABLE STREAM).
W69-08135 06E

POWERS OF THE GOVERNOR AND COUNCIL. W69-08193 06E

UNITED STATES V LOUISIANA (SUIT BY FEDERAL GOVERNMENT AGAINST STATE TO DETERMINE CONTROL OF AREA OUTSIDE 3 MILE BELT).
#69-08597

OXYGEN DEMAND DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS, $\ensuremath{\text{W}}69-083\,94$

OXYGEN DIFFUSION RATE RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 05D

WATER TABLE, SOIL MOISTURE, AND OXYGEN DIFFUSION EPLATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, M69-08443

OXYGEN REQUIREMENTS
EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLDWATER FISHES,
W69-08516
05C

OXYGENATION
TRANSFER OF OXYGEN IN AQUEOUS SOLUTIONS, W69-08217 052

OYSTERS
TAKING OYSTERS FROM CERTAIN WATERSW69-08162
06

THE CONCENTRATION OF ZN-65 BY OYSTERS MAINTAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT, w69-08268 05C

PACIFIC OCEAN
AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM,
M69-08271
05B

RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, 969-08530

PALEOCLIMATOLOGY
PALEOLIMBETIC SALINITY OF DZUNGAR AND ORDOS BASINS, #69-08594 02H

PALEOCURRENT INDICATORS

"PEBBLE CLUSTERS" THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAEOCURRENTS,

#69-08608 02J

PALEOHYDROLOGY

PEBBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAEOCURRENTS, M69-08608

02J

PALEOLIHNOLOGY PALEOLIHNETIC SALINITY OF DZUNGAR AND ORDOS BASINS, $\theta 69-0.8594$ 02H

PALEOSALINITY
PALEOLIMMETIC SALINITY OF DZUNGAR AND ORDOS BASINS,
#69-08594 02H

PALLMANN METHOD WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, W69-08378 02D

PANS SEASONAL VARIATION IN ALKALINITY IN PANS IN CENTRAL APRICA, W69-08301

PARKS
DIVISION OF PARKS AND RECREATION.
W69-08317 06E

PARTICLE SHAPE
A CONTACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTICLES, W69-08584
07B

A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL PRAGMENTS, W69-08585 07B

PARTICLE SIZE STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE, W69-08258 02J

THE SIGNIFICANCE AND LINITATIONS OF STATISTICAL PARAMETERS

POR DISTINGUISHING ANCIENT AND MODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN, AN INEXPENSIVE RECORDING SETTLING TUBE FOR ANALYSIS OF 07B CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SPTTLING TUBE, 469-08583 07B A CONTACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MFASUREMENT OF LOOSE SAND PARTICLES, W69-08584 A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY AND SIZE OF GRAVEL FRAGMENTS, W69-08585 PATHOGENIC BACTERIA
THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS, PATUXENT RIVER PATUXENT RIVER WATERSHED. W69-08147 06E THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM METEOROLOGICAL EVENTS, W69-08435 IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD, FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION, 040 PEAK DISCHARGES
RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND PERNCOVERED AND BURNED WATERSHEDS IN HAWAIT, PEARL RIVER BASINS
GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, PERBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAEOCURRENTS, W69-08608 DAMS AND PLOWAGE (ADMINISTRATION, PROCEDURE, AND APPEALS OF NEW HAMPSHIRE WATER RESOURCES BOARD). W69-08345 PENNSYLVANIA
BOROUGH OF WINDBER V SPADAFORA (CONSTRUCTION EXTENDING INTO
NON-NAVIGABLE WATER).

QGE THE VERTICAL MOVEMENT OF WATER IN STRATIFIED POROUS MATERIAL. 2. TRANSIENT STAGES OF DRAINAGE TO A WATER TABLE, W69-08203 PERENNIAL STREAMS
GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING
MOUNTAIN BOG,
W69-08457
05B PERIODIC OBSERVATIONS
WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968,
W69-08588 02P PERMEABILITY SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW COVER, W69-08453 PERMITS UNDERGROUND GAS STORAGE. W69-08138 06E MINERAL LANDS AND LEASES. W69-08145 EXCAVATING AND DREDGING IN PUBLIC WATERS. PESTICIDE RESIDUES
EPPECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER-BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W69-08565 PESTICIDES
SOME EFFECTS OF PESTICIDES ON MISSISSIPPI WATERS,

ZINC BY A MARINE UNICELLULAR ALGA, w69-08275PHENOLOGY WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, W69-08378 PHOSPHATES
MINES AND MINERALS. 06E W69-08371 PHOSPHORUS PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS, PHOSPHORUS RADIOISOTOPES
THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, 469-08274
05c PHREATOPHYTES
GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, w69-08491 03B PHYSICAL PROPERTIES WATER QUALITY AS APPECTED BY A WYOMING MOUNTAIN BOG, $M69\!-\!08455$ PHYSICS
SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL OF CHAPARRAL, W69-08483 EFFECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER QUALITY, W69-08484 PINE TREES WIND DAMAGES IMPROPERLY PLANTED SLASH PINE, W69-08442 04A MUNICIPAL PUBLIC WORKS. W69-08178 04 8 GOLDIN V TRUSTEES OF VILLAGE OF ELLENVILLE (INTERFERENCE WITH WATER SUPPLY BY CITY). W69-08355 04C PITTING(CORROSION)
ELECTRON MICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL ABRASION FEATURES ON QUARTZ SAND GRAINS, PLANNING
SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES FIELD, W69-08381 RESEARCH ON COMPREHENSIVE PLANNING OF WATER-RESOURCE SYSTEMS, W69-08382 06B REVIEW OF SURFACE WATER SYSTEMS ANALYSIS, 067-08533 OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORATORY, W69-08534 05D AN APPLICATION OF NON-LINEAR PROGRAMMING TO THE PLANNING OF MUNICIPAL WATER SUPPLY SYSTEMS SOME RESULTS, W69-08535 06 A CHINKING UP SOME CRACKS, W69-08539 06A DETRIMENTAL EFFECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN WEST-CENTRAL NEW MEXICO, PLANTING MANAGEMENT WIND DAMAGES IMPROPERLY PLANTED SLASH PINE, W69-08442 044 SURPACE RUNOPP AND EROSION IN THE LOWER CHAPARRAL ZONE, ARIZONA, W69-08474 PLANT-WATER RELATIONS
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA
CHAPARRAL COMMUNITIES, PLATICHTHYS STELLATUS
RADIOZINC DECLINE IN STARRY FLOUNDERS AFTER TEMPORARY
SHUTDOWN OF HANFORD REACTORS,
W69-08270
05C DISONS
POLLUTION, POISONING, ETC., OF STREAMS D
05G DYNAMITING. W69-08366 POLAND
AN OUTLINE OF POLAND'S HYDROGRAPHY (POLISH),

¥69-08253

POLICE POWER AND DUTIES OF THE COMMISSIONER OF CONSERVATION. #69-08144 06E

POLITICAL ASPECTS
SOIL CONSERVATION DISTRICTS.
W69-08336

04D

028

OLLUTANTS
POLLUTION, POISONING, ETC., OF STREAMS DYNAMITING.
W69-08366
OSG

POLLUTION ABATEMPNT WATER POLLUTION CONTROL. W69-08127

05G

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION). W69-08172

SEWERAGE AUTHORITIES LAW.

05G

POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA. W69-08358

CHINKING UP SOME CRACKS, W69-08539

06A

A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, W69-08542 $\,$ 05D

OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, W69-08547

POLLUTION ABUTEMENT
THE PRONOMICS OF CLEAN WATER,
W69-08548

05F

PONDEROSA PINE TREES
MOISTURE LOSS AND WEIGHT OF THE FOREST PLOOR UNDER POLE-S12E
PONDEROSA PINE STANDS,
W69-08461

02G

PORT AUTHORITIES
TIDAL WATERS.
W69-08343

043

POST-FIRE EROSION
BURNED CHAPARRAL TO GRASS EARLY EFFECTS ON WATER AND
SEDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN
ARIZONA,
MCG-08455

POTABLE WATER
STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY.
W69-08186
06E

STATE BOARD OF HEALTH, RAILROADS, WATER AND ICE SUPPLIES. W69-08187 $06\,E$

POTENTIAL EVAPOTRANSPIRATION
POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN
WESTERN STATES WITH EMPHASIS ON CALIFORNIA,
W69-08308
02D

POTOMAC RIVER BASIN
A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER,
W69-08487

POWER OPERATION AND MAINTENANCE AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN OPERATION OF A SYSTEM OF DAMS, W69-08536 04A

POWER PLANT
ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN,
W69-08409 05C

POWER PLANTS
ESTINATING FORCED EVAPORATION FROM COOLING PONDS,
W69-08414
05C

SURFACE DISCHARGE OF HORIZONTAL WARM-WATER JET, w69-08421

PRECIPITATION EXCESS

WESTERN AND ATLANTIC BAILBOAD V HASSLER (DANAGES CAUSED BY INADEQUATE CULVERT).

W69-08132 06E

PRECIPITATION GAGES
PRECIPITATION IN NORTHERN QUEBEC AND LABRADOR AN
EVALUATION OF HEASUREMENT TECHNIQUES,
USG_08587
028

PRECIPITATION(ATHOSPHERIC)
PRECIPITATION IN NORTHERN QUEBEC AND LABRADOR AN
EVALUATION OF MEASUREMENT TECHNIQUES,
02B

PRESCRIBED BURNING
REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED PALL BURNING
OF OAK-HOUNTAINBAHOGANY CHAPARRAL,
M69-08470
021

PREVENTATIVE TREATHENT PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER

SUPPLIES, W69-08282

05C

PRINCIPAL COMPONENTS ANALYSIS
SNOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND
DRY YEARS,

WHEN IS IT SAPE TO EXTEND A PREDICTION EQUATION—AM ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS, W69-08509 07B

PROBABILITY
PHYSICAL AND ECONONIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS,
W69-08459
03B

SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC SERIES, W69-08614 07C

PRODUCTIVITY
MORPHOMETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF
LARGE LAKES,
W69-08519
028

PROJECT PLANNING
THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS,
U49-08766 06B

CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER, W69-08386 06B

REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION, w69-08391

OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES PROBLEMS, W69-08393 06B

PROJECTS
STATE W BENTLEY (WATER DAMAGE).
W69-08566 06E

PROTEIN UTILIZATION
INPLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN
METABOLISM OF BLUEGILL SUNFISH,

PUBLIC BENEFITS
PUBLIC LANDINGS.
W69-08332 06B

PROCEDURE TO ESTABLISH DISTRICTS. W69-08340 04A

PUBLIC HEALTH
PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION,
W69-08216
05G

PROTECTING WATER AND ICE SOURCES. W69-08348 05G

W69~08350 05G

PUBLIC LANDING
PUBLIC LANDINGS.
W69-08332
06E

PUBLIC RIGHTS
PLACING FILL IN PUBLIC WATERS.
W69-08346
04A

PUBLIC TRUST DOCTRINE

CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDENNATION VALUE OF ACCRETED LAND).

869-08140

06E

PUBLIC UTILITIES
CITT OF REW YORK V BROOKLYN BOROUGH GAS CO (PUBLIC UTILITIES RIGHT TO NAVIGABLE STREAM).
W69-08135

PUBLIC SERVICE COMPANIES. w69-08369 06

PUBLIC WATERS

EXCAVATING AND DREDGING IN PUBLIC WATERS.

W69-08342

O4A

PUBLICATIONS
EMOSION AND SEDIMENTATION,
#69-08507 02J

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC IMPORMATION FOR SMALL GROUPS OR INDIVIDUALS, #69-08511 07C

QUALITY CONTROL
ESTUARTAL SYSTEMS AWALYSIS QUANTITY AND QUALITY
CONSIDERATIONS,
W69-08537
02L

QUARTZ
ELECTRON HICROSCOPY OF CHEHICAL SOLUTION AND MECHANICAL ABRASION FEATURES ON QUARTZ SAND GRAINS, W69-08607

02J

W69-08435

```
PADIOACTIVE TRACERS
TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH
ACID KAOLINITIC SOIL,
RADIOACTIVE WASTE DISPOSAL PRVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS,
   STATUS OF RADIOACTIVE WASTE DISPOSAL IN U.S.A.,
   PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION,
RADIOACTIVE WASTES ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS,
   W69-08212
   CONDITIONS FOR COEXISTENCE OF AQUATIC COMMUNITIES WITH THE
   EXPANDING NUCLEAR POWER INDUSTRY,
RADIOACTIVITY
   TRANSFER OF ZN-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN,
RADIOCARBON SURFACE-WATER INPILTRATION AND GROUNDWATER MOVEMENT IN ARID ZONES OF VENEZUELA, $\text{W}69\text{-}08306$
RADIOCHEMICAL ANALYSIS
ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS,
RADIOISOTOPES
DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENIMETOK
   AND BIKINI ATOLS, AUGUST 1964,
   GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING
   MOUNTAIN BOG,
W69-08457
   THE EFFECT OF TEMPERATURE, SEDIMENT, AND PEEDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,
   W69-08522
   SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITANS AND S
   W69-08524
   ACCUMULATION OF FALLOUT NABIOLOGY, FROM THE LOWER TRENT AND NEUSE RIVERS, 05C
   ACCUMULATION OF FALLOUT RADIOISOTOPES BY BIVALVE MOLLUSCS
   RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, W69-08530
RADIONUCLIDE ELIMINATION ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON,
PADIONUCLIDE TRANSPORT ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON,
   W69-08529
RADIONUCLIDE UPTAKE
   DIDUNCTION BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA,
                                                      05C
  THE PPRECT OF TEMPERATURE, SEDIMENT, AND PREDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD, M69-08522
 RAILROADS
   STATE BOARD OF HEALTH, RAILROADS, WATER AND ICE SUPPLIES. W69-08187
   POWER TO CROSS ROADS, HIGHWAYS AND STREAMS CROSSING CANALS OR NAVIGABLE WATERS.
   H69-08330
   PUBLIC SERVICE COMPANIES.
                                                      06 E
     OMPARISON BETWEEN RAIN GAGE AND LYSIMETER MEASUREMENTS.
   ¥69-08208
RAIN WATER
SHITH V BOARD OF COUNTY ROAD COMMISSIONERS OF CHIPPEWA
COUNTY (FLOOD DAMAGE CAUSED BY ROAD CONSTRUCTION AND ACT OF
```

AINPALL DISPOSITION
A DIGITAL COMPUTER PROGRAM TO PLOT ISOMYETAL MAPS AND
CALCULATE VOLUMES OF PRECIPITATION,
W69-08238
07C

THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM METEOROLOGICAL EVENTS,

INPALL INTENSITY
WESTERN AND ATLANTIC RAILROAD V HASSLER (DAMAGES CAUSED BY INADEQUATE CULVERT).

RAINFALL RUNOFF RELATIONS
RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND FERNCOVERED AND BURNED WATERSHEDS IN HAWAII,
W69-08510
O2G RAINFALL-RUNOFF RELATIONSHIPS
A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO
THEIR EPPECTIVENESS IN SOLVING RUNOFF ANALYSIS,
02A LAG TIME OF NATURAL CATCHMENTS, 02E EPPECT OF HEAVY LATE-FALL PRECIPITATION ON RUNOFF FROM A CHAPARRAL WATERSHED, W69-08285 SOURCE AREAS OF STORM RUNOPF, w69-08569 02A OPTIMAL IDENTIFICATION OF LUMPED WATERSHED MODELS, W69-08570 02A SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY RAINFALL AND RUNOPF, W69-08572 RANGE SCIENCE INPLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT W69-08462 DEPERRED GRAZING AND SOIL RIPPING IMPROVES FORAGE ON NEW MEXTCO'S RIO PUERCO DRAINAGE, W69-08463 DETRIMENTAL EFFECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN WEST-CENTRAL NEW MEXICO, W69-08464 02G INPLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE GRASSES, W69-08467 REASONABLE USE
THOMAS V LACOTTS (REASONABLE USE OF RIPARIAN WATERS).
W69-08133
06E ETKIN V HYNEY (LEGAL CONSTRUCTION OF RESTRICTIVE COVENANT). RECHARGE WELLS
EFFECT OF SEDIMENT CONCENTRATION ON WELL RECHARGE IN A PINE SAND AQUIFER, RECIRCULATED WATER RETURN PLOWS A REUSABLE WATER RESOURCE, W69-08259 WATER REUSE IN SPACE, W69-08261 RECIRCULATION OF COOLING WATER IN RIVERS AND CANALS, RECLAIMED WATER RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, $\ensuremath{\mathsf{W69-08215}}$ RETURN FLOWS A REUSABLE WATER RESOURCE. W69-08259 REUSE CAN BE CHEAPER THAN DISPOSAL, 05D WATER REUSE IN SPACE, W69-08261 05D PRACTICAL IRRIGATION WITH SEWAGE EFFLUENT, GROUNDWATER RECHARGE WITH TREATED MUNICIPAL EFFLUENT, SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS, W69-08622 A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION, W69-08623 051 RECLAMATION DRAINAGE RESEARCH IN THE COASTAL PLAIN, FOREST W69-08437 SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, W69-08441 044

WIND DAMAGES IMPROPERLY PLANTED SLASH PINE,

GOD). #69-08192

W69-08132

SUBJECT INDEX REC-RIP

W69-08382

RESEARCH ON COMPREHENSIVE PLANNING OF WATER-RESOURCE

W69-08442 RECOVERY(WASTE)
WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, 469-08556 05D RECREATION WATER SKIS, SURPBOARDS AND AQUAPLANES REGATTAS, ETC. W69-08156 ETKIN V HYNEY (LEGAL CONSTRUCTION OF RESTRICTIVE COVENANT). W69-08174 06E AN PCOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIVER, W69-08399 06G BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, W69-08563 RECREATION PACILITIES PUBLIC LANDINGS. W69-08332 068 RECREATIONAL PACILITIES
DIVISION OF PARKS AND RECREATION.
W69-08317 OFF PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN THE RED SEA. W69-08581 PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS, ¥69-08526 GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL POR FIELD AND OFFICE WORK, W69-08227 REGIONAL ANALYSIS
REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-08387 MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE SYSTEMS, W69-08541 REGRESSION AMALYSIS
CHEMICAL CHANGES IN COOLING WATER TOWERS,
W69-08402
058 THE WORKMAN CREEK EXPERIMENTAL WATERSHED, WATER YIELDS RESULTING FROM TREATMENTS APPLIED TO MIXED CONIFER WATERSHED, W69-08477 MULTIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON USING DATA OF KNOWN FUNCTIONAL RELATIONSHIP, ¥69-08499 07B WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, ¥69-0850# WHRN IS IT SAPE TO EXTEND A PREDICTION EQUATION--AW ANSWER BASED UPON FACTOR AND DISCRIMINANT PUNCTION ANALYSIS, W69-08509 POLICE POWER AND DUTIES OF THE COMMISSIONER OF CONSERVATION. W69-08144 REGULATION TAKING OYSTERS FROM CERTAIN WATERS. W69-08162 POSSESSION OF CERTAIN MARINE LIFE. 068 SEASONS, WATERS, LIMITS. W69-08168 OFF TRESPASSING ON PRIVATE DOCKS. W69-08183 06 E ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS, \$169-08212 PUBLIC HEALTH PACTORS IN REACTOR SITE SELECTION,

DIGITAL COMPUTER APPLICATIONS TO GREAT LAKE REGULATION, W69-08242

PROPAGATION AND CONTROL OF FISH AND WILD ANIHALS. #69-08169

RESEARCH NEEDS
SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES
FIELD,
M69-08381
06B

WATURAL RESOURCES. W69-08335

FUTURE ECONOMICS RESEARCH ON WESTERN WATER RESOURCES -- WITH PARTICULAR REPERENCE TO CALIFORNIA, W69-08383 ECONOMIC AND RELATED PROBLEMS IN CONTEMPORARY WATER RESOURCES MANAGEMENT, W69-08384 RESERVOIR DESIGN
GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM
STREAMFLOW REGULATION,
07C RESERVOIR OPERATION
AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN
OPERATION OF A SYSTEM OF DAMS, W69-08536 RESERVOIR SILTING
SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC
COAST BASINS IN OREGON AND CALIFORNIA,
02A RESERVOIRS

ACQUISITION OF LAND BY UNITED STATES FOR FLOOD CONTROL AND NAVIGATION. W69-08352 SELECTIVE WITHDRAWAL FROM DENSITY - STRATIFIED RESERVOIRS, W69-08419 BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, ¥69-08563 RESINS
A COMPARISON BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 RESOURCE ALLOCATION

MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE RESOURCE DEVELOPMENT W69-08392 RESPONSE RATE
AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM, W69-08271 RETURN FLOWS A REUSABLE WATER RESOURCE, W69-08259 05D REVERSE OSMOSIS VERSE OSMOSIS
REVERSE OSMOSIS MEMBRANE REGENERATION,
03A SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION, #69-08502 REVIEWS A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL. #69-08199 05 D STATUS OF RADIOACTIVE WASTE DISPOSAL IN U.S.A., W69-08214 GENERAL REPORT SYMPOSIUM SUBJECT NEW IDEAS A METHODS IN STOCHASTIC (STATISTICAL) HYDROLOGY, W69-08505 07B NEW IDEAS AND SCIENTIFIC EROSION AND SEDIMENTATION, W69-08507 02.1 W69-08518 RICHARDSON NUMBER
DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE,
W69-08412
08B WATERS AND WATERCOURSES NORTH CAROLINA LINE TO WINYAH BAY. W69-08157 GUESS V AZAR (RIGHT OF WAY ACROSS PRIVATE PROPERTY). W69-08322 RINGERT V REEVES (EASEMENT FOR IRRIGATION CANAL). 069-08538RIPARIAN CUT
WATER TIELDS RESULTING FROM TREATMENTS APPLIED TO MILED
CONFIPER WATERSHED,
W69-08477 03B RIPARIAN HARDWOODS PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIANT REGION, W69-08489

RIP-SAR

RIPARIAN LAND
CLEVELAND BOAT SERVICE V CITY OF CLEVELAND (CONDEMNATION VALUE OF ACCRETED LAND). SPECIFIC GRANTS OR CESSIONS. W69-08182 06 B GARRISON FURNITURE CO. V SOUTHERN ENTERPRISES, INC. RIPARIAN PLANTS
PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A
SERIARD REGION, 038 RIPARIAN RIGHTS THOMAS V LACOTTS (REASONABLE USE OF RIPARIAN WATERS). W69-08133 06E RIVERS AND STREAMS AS LAWPUL FENCES. FLOATING TIMBER AND DAMAGE THEREFROM. GARRISON FURNITURE CO. V SOUTHERN ENTERPRISES, INC. (AVULSION). W69-08374 SUSQUEHANNA FLATS. W69-08492 BOROUGH OF WINDBER V SPADAFORA (CONSTRUCTION EXTENDING INTO NOW-NAVIGABLE WATER). W69-08567 06E RISKS
THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS, W69-08266 CHINKING UP SOME CRACKS, W69-08539 06A STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, RIVER BASIN COMMISSIONS
NORTH AMERICAN WATER SUPPLY PROBLEMS AND THEIR SOLUTION, W69-03180 06B RIVER BASIN DEVELOPMENT
MISSISSIPPI WATER RESOURCE CONFERENCE - 1969. A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-08487 GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESE), 027 A PIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, W69-08544 RIVER BEDS HIGHWAYS (USE OF LANDS UNDER DELAWARE RIVER). RIVER FOR ECASTING
AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM
RIVER RORECASTS ON THE NORTH COAST OF CALIFORNIA,
024 USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES, W69-08624 RIVER REGULATION THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF REGULATION, W69-08626 RIVERS RIVERS AND STREAMS AS LAWFUL FENCES. W69-08328 068 LEGAL FENCES WATERS, WHEN NOT SUFFICIENT PENCE. W69-08363 THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS, 869-08422THE SEDIMENTOLOGY OF A BRAIDED RIVER, ROAD CONSTRUCTION
BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMM'N (WATER DAMAGE FROM DIVERSION). 040 STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. W69-08338 ROAD CONSTRUCTION. W69-08365

ROOTING DEPTH

EFFECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOLSEASON FORAGE SPECIES, W69-08425 027 ROSS BARNETT RESERVOIR
BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, W69-08563 05B HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM, SOME PROBLEMS OF STREAMPLOW PORECASTS BASED ON INFORMATION W69-08241 02E LAG TIME OF NATURAL CATCHMENTS, 028 GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL WATERSHEDS OF CENTRAL ARIZONA, W69-08476 OBSERVATIONS OF SNOWPACK ACCUMULATION, NELT, AND RUNOFF ON A SMALL ARIZONA WATERSHED, W69-08493 SOURCE AREAS OF STORM RUNOFF, W69-08569 RUNOFF PORECASTING
LAG TIME OF NATURAL CATCHMENTS,
W69-08250 AREAL EXTENT OF SNOW COVER IN RELATION TO STREAMPLOW IN CENTRAL COLORADO. W69-08454 SAFETY EQUIPMENT AND OPERATION OF VESSELS. W69-08347 06E FENCING WATER-WAYS. W69-08362 SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-D, W69-08460 POSSESSION OF CERTAIN MARINE LIFE. EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC WATER POTENTIAL DIFFERENCES BETWEEN ROOT XYLEM AND EXTERNAL MEDIUM W69-08291 SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION, SALMO GAIRDNERI PRODUCTION OF JUVENILE STEELHEAD TROUT IN A PRESHWATER IMPOUNDMENT, W69-08517 02H SALMON RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, W69-08530 050 THE PHOSPI MARSH, W69-08274 PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT SAMPLING SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS, W69-08223 DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SUBFACE WATER IN A SMALL WATERSHED, W69-08234 07C SAN DIMAS EXPERIMENTAL FOREST(CALIF)
SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN
SOUTHERN CALIFORNIA, W69-08201 SAN FRANCISCO BAY-DELTA SYSTEM
ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY
CONSIDERATIONS, 869-08537 ELECTRON HICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL ABRASION FRATURES ON QUARTZ SAND GRAINS, W69-0860. SARGASSUM PLUITANS
SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITANS AND S NATANS, W69-08524 SARGASSUM NATANS

SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM FLUITANS AND S NATANS, W69-08524 GROUNDWATER POTENTIAL OF KARST AQUIFERS IN SAUDI ARABIA, W69-08296 SAVANNAH RIVER NAVIGATION COMMISSION SAVANNAH RIVER NAVIGATION COMMISSION. W69-08160 EROSIONAL CURRENT MARKS OF WEAKLY COHESIVE MUD BEDS, TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS, ASSIGNED OF LAND PROPERTIES INC (CONDEMNATION OF LAND FOR USE AS 9 SPASONAL SEASONAL VARIATION IN ALKALINITY IN PARS IN CENTRAL AFRICA, W69-08301 SEDIMENT DISCHARGE
MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER,
W69-08498 03B SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, W69-08501 02A SEDIMENT DISTRIBUTION

PREBBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE STUDY OP PALAEOCURRENTS, w69-08608

02J IMPORTANT WATERSHED CHARACTERISTICS APPRICTING WATER YIELD, FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION, W69-08508 SEDIMENT TRANSPORT
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE,
W69-08258 02J EROSION AND SEDIMENT MOVEMENT POLLOWING A WILDPIRE IN A PONDEROSA PINE POREST OF CENTRAL ARIZONA, W69-08475 PROSION AND SEDIMENTATION, W69-08507 0.2.1 DISPERSION OF SILT PARTICLES IN OPEN CHANNEL FLOW, *PERBLE CLUSTERS* THEIR ORIGIN AND UTILIZATION IN THE STODY OF PALAEOCURRENTS, W69-08608 02J SEDIMENT YIELD AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK DESIGN. W69-08497 07A IMPORTANT WATERSHED CHARACTERISTICS APPECTING WATER YIELD, PLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION, SEDIMENTARY STRUCTURES

EROSIONAL CURRENT MARKS OF WEAKLY COHESIVE MOD BEDS. W69-08579 SEDIMENTATION
NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING
SEA AND THE GULP OF ALASKA,
M69-08249
02J THE WORKHAN CREEK EXPERIMENTAL WATERSHED, W69-08473 erosion and sedimentation, w69-08507 02J EFFECT OF SPRINENT CONCENTRATION ON WELL RECHARGE IN A FINE SAND AQUIPER, #69-09574 RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER PLORIDA KEYS, W69-08577 02L THE SIGNIFICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND HODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN,

PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN THE RED SEA, W69-08581 02J

SEDIMENTOLOGY SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS,

SAR-SIM M69-08223 02J THE SEDIMENTOLOGY OF A BRAIDED RIVER, SEDIMENTS
STUDIES ON CONNECTICUT LARE SEDIMENTS. II. CHEMICAL
ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRANFORD,
W69-08521
02H THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE BEHAVIOR OF FOUR BADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD, W69-08522 ZINC-65 IN ECHINODER'S AND SEDIMENTS IN THE MARINE ENVIRONMENT OFF OREGON, A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO SEDIMENTS, W69-08586 SEDIMENTS TOPOGRAPHY
GLACIAL AND FLUVIO-GLACIAL FORMATIONS OF THE LYON REGION (FRENCH), W69-08627 EPAGE THE VERTICAL MOVEMENT OF WATER IN STRATIFIED POROUS MATERIAL. 2. TRANSIENT STAGES OF DRAINAGE TO A WATER ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID OF ELECTRONIC COMPUTERS (FRENCH), M69-08231 TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS, W69-08576 SELF-PURIFICATION
BIOLOGICAL OXIDATION RATES IN HINE ACID WATER REGIMES, W69-08379 05G SETTLING BASINS WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 SETTLING VELOCITY
AN INEXPENSIVE RECORDING SETTLING TUBE FOR ANALYSIS OF CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SETTLING TUBE, W69-08583 SEWAGE
SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE WATER, W69-08400 SEWAGE DISPOSAL SYSTEMS NEAR SHORBLINES. W69-08154 SEWAGE EFFLUENTS
RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGBICULTURAL CROPLAND AND FORESTLAND,
05D SEWAGE TREATMENT
SEWAGE DISPOSAL SYSTEMS NEAR SHORELINES.
W69-08154
05E POTENTIAL REUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN, COMPLETE WATER REUSE, W69-08263 05D SHEET EROSION
EROSION AND SEDIMENTATION,
W69-08507 02J SHELTERBELTS
REEP MAINE SCENIC ALLAGASH RIVER AUTHORITY. W69-08131 WATER-PRONT INPROVEMENTS. 06E THERMAL EPPLUENT MAY CUT COST OF SHRIMP COCKTAIL. #69-08401 MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CEAPABRAL COMMUNITIES, W69-08488 SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE PLOW PROBLEM, W69-08575 SIMULATION ANALYSIS
HATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND

SIM-SNO · SUBJECT INDEX

28

OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR INFLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SNOW FENCE ON SIZE AND LOCATION OF LEE DRIFT, W69-08450 SALINE WATER CONVERSION, W69-08549 PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS, THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A PLANT SITE, W69-08553 W69-08459 MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER, SMALL WATERSHEDS DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SMALL WATERSHED, INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT, W69-08234 SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, W69-08506 A SIMPLE SNOWMELT LYSIMETER, W69-08206 0.20 SNOW CATCH BY CONIFER CROWNS, SNOW METAMORPHOSIS 0.2C SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW INFLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SNOW PENCE OF SIZE AND LOCATION OF LEE DRIFT, COVER, W69-08453 02C 0.2C SNOWDRIPTS
INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT, SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW W69-08503 W69-08451 SNOWFALL SNOW ACCUMULATION ON MOUNT LOGAN, YUKON TERRITORY, CANADA. 02C SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN UNITED STATES, W69-08446 USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED THE WEATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES, SNOW AVALANCHES AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS FUTURE PROSPECTS, SIMPLE SNOWMELT LYSIMETER, AN EXAMPLE OF DANAGE FROM A POWDER AVALANCHE, ¥69-08206 02C ¥69-08449 THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM METEOROLOGICAL EVENTS, SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN UNITED STATES, W69-08435 OBSERVATIONS OF SNOWPACK ACCUMULATION, MELT, AND RUNOFF ON A W69-08446 020 SMALL ARIZONA WATERSHED, W69-08493 03B THE WEATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES, W69-08448 OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEMONSTRATION CUTTINGS OF PONDEROSA PINE IN CENTRAL ARIZONA, W69-08494 03B 02C SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER, ATMOSPHERIC HUMIDITY MEASUREMENT NEAR THE SNOW SURFACE, W69-08452 SNOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND DRY YEARS, W69-08500 SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW COVER, W69-08453 GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING W69-08457 AREAL EXTENT OF SNOW COVER IN RELATION TO STREAMFLOW IN CENTRAL COLORADO, W69-08454 SNOWPACK TEMPERATURE SNOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES, DRY YEARS, W69-08500 02C W69-08469 SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND POREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, W69-08506 02C AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS AND FUTURE PROSPECTS. SNOW DENSITY
USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED SNOW AVALANCHES ALONG COLORADO MOUNTAIN HIGHWAYS, MANAGEMENT, W69-08445 07B MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES, SNOW FALL
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC,
AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
169-08506 02C W69-08447 AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE, SNOW FENCES
PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW INFLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SNOW PENCE ON SIZE AND LOCATION OF LEE DRIFT, w69-08450 ACCUMULATION PROJECTS, W69-08459 038 SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW SNOW GAGES
A SIMPLE SNOWMELT LYSIMETER, COVER, W69-08453 02C A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOW HYDROLOGY USE OF NUCLEAR TECHNIQUES IN SNOW AND RELATED WATERSHED SNOWPACK TEMPERATURES, W69-08469 MANAGEMENT, OBSERVATIONS OF SNOWPACK ACCUMULATION, MELT, AND RUNOFF ON A SMALL ARIZONA WATERSHED, SNOW MANAGEMENT
AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS
AND FOTURE PROSPECTS,
W69-08444
02C W69-08493 OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEMONSTRATION CUTTINGS OF PONDEROSA PINE IN CENTRAL ARIZONA, W69-08494 SNOW AVAILANCHES ALONG COLORADO HOUNTAIN HIGHWAYS, M69-08445 INTEGRATING SNOW ZONE MANAGEMENT WITH BASIN MANAGEMENT, W69-08503 A MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES, #69-08447 SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, SUBJECT INDEX

AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, SNOW-COVER DEPLETION
AREAL EXTENT OF SNOW COVER IN RELATION TO STREAMPLOW IN
CENTRAL COLORADO,
M69-08454
02C CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL BESEARCH ON THE PRODUCTS OF WATER, W69-08386 SOIL AERATION
RENOVATION OF WASTE WATER THROUGH APPLICATION TO
AGRICULTUBAL CROPLAND AND FORESTLAND,
05D SOIL AGGREGAGES ERODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS RELATED TO SOIL FORMING FACTORS, W69-08482 SOIL AGGREGATES
SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA FOREST SITES, M69-08513 SOIL CONSERVATION PLOOD CONTROL AND SOIL CONSERVATION. ¥69-08130 044 SOIL CONSERVATION DISTRICTS. W69-08336 SOIL CONSERVATION AND IMPROVEMENT. W69-08370 04D SOIL DISPOSAL FIELDS
CROP RESPONSE TO SEWAGE EFFLUENT, W69-08617 SOIL FORMATION

PRODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS RELATED TO SOIL PORMING FACTORS, M69-08482

02J SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA FOREST SITES, W69-08513 02G SOIL HOISTURE
SOIL HOISTURE REGIME EFFECT QN YIELD AND EVAPOTRANSPIRATION
PROM WARM SEASON PERENNIAL PORAGE SPECIES,
02D EFFFCTS OF SOIL MOISTURE REGIME ON YIELD AND EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE SPECIES, W69-08427 0.20 EVAPOTRANSPIRATION BY IRRIGATED CORN, EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND BYA POTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-0842 02D $\,$ YIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL MOISTURE, W69-08433 021 WATER TABLE, SOIL MOISTURE, AND OXYGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, 0.03 SOIL HOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-W69-08460 02T PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF 0.2G MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES, 02G PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO, W69-08396 SOIL SCIENCE PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF NEW MEXICO, W69-08865 SOIL STABILITY SUMMARY OF FORESTS AND SOIL STABILIZATION SESSION, $M69-08502 \\ 04D$ SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS,

SOIL-WATER-PLANT RELATIONSHIPS
SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN SOUTHERN CALIFORNIA, SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-W69-08460 MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ABIZONA CHAPARRAL COMMUNITIES, W69-08488 SOLUTES PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN WISCONSIN, W69-08205 SORPTION SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM FLUITANS AND S NATANS. W69-08524 SOUTH CAROLINA
DRAINAGE DISTRICTS UNDER 1911 ACT.
W69-08152 044 LOCAL PROVISIONS. W69-08155 05G WATER SKIS, SURPBOARDS AND AQUAPLANES REGATTAS, ETC. W69-08156 WATERS AND WATERCOURSES NORTH CAROLINA LINE TO WINYAH BAY. W69-08157 LANDOWNERS IN YORK COUNTY TO CLEAN OUT STREAMS. LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT W69-08159 SAVANNAH RIVER NAVIGATION COMMISSION. M69-08160 STATE BOARD OF HEALTH WATER. AUTHORIZATION, CONSTRUCTION AND MAINTENANCE OF BRIDGES. W69-08170 SUITS FOR INJURIES ON HIGHWAY. SEINES, TRAPS, OBSTRUCTIONS IN STREAMS, ETC GENERALLY. W69-08173 RELATIONS WITH PEDERAL GOVERNMENT CERTAIN STATE-OWNED LANDS. W69-08175 06 P MUNICIPAL PUBLIC WORKS. W69-08178 PUBLIC WORKS AUTHORIZED UNDER ARTICLE. W69-08179 WATER-PRONT INPROVEMENTS. W69-08180 LIGHTHOUSES AND OTHER AIDS TO NAVIGATION. W69-08181 SPECIFIC GRANTS OR CESSIONS. 06E TRESPASSING ON PRIVATE DOCKS. 06E STATE BOARD OF HEALTH, POOD PROCESSING LAWS, WATER SUPPLY. STATE BOARD OF HEALTH, BAILROADS, WATER AND ICE SUPPLIES. W69-08187 STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. MES-08338 CONSTRUCTION OF IMPROVEMENT. OAR PROCEDURE TO ESTABLISH DISTRICTS. W69-08340 DUA EQUIPMENT AND OPERATION OF VESSELS. CLASSIFICATION OF WATERS AWD STANDARDS OF PURITY. W69-08353 POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA. SOUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING COMMITTEE. W69-08359

PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF

PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF

THE SIGNIFICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND MODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN, W69-08365 021 POLLUTION, POISONING, ETC., OF STREAMS DYNAMITING. SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS, PUBLIC SERVICE COMPANIES. GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMFLOW REGULATION, 06E 07C SOIL CONSERVATION AND IMPROVEMENT. N69-08370 04D PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTATIONS OF STREAMPLOW REGULATION, 469-08613 07C MINES AND MINERALS. 06E W69-08613 SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC INTERFERENCE WITH NAVIGATION, ETC. SERIES, W69-08614 04A MISCELLANEOUS PROVISIONS (UNLAWPUL DISCHARGE OF OIL IN THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF CHARLESTON HARBOR). W69-08373 REGULATION, W69-08626 SOUTHEAST U STATISTICAL MODELS THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON NETS OF VARIOUS ORDERS, W69-08392 06B W69-08211 SOUTHWEST U VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE WATER TABLE, SOIL MOISTURE, AND OXYGEN DIPPUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, W69-08443 SPACECRAPT WASTES WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC WATER REUSE IN SPACE, POTENTIAL OF UNIT AREAS, W69-08261 0.50 02 A SPARTINA ALTERNIFLORA
THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIFLORA IN RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD NETWORKS, W69-08571 W69-08277 USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES, SPRINGS CAMPBELL V STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDEMNATION OF A SPRING AND AN EASEMENT). W69-08624 STEAM ACTIVATION W69-08321 AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, SPRINKLER IRRIGATION NET LOSSES IN SPRINKLER IRRIGATION, W69-08305 03F STANDARDS REGIONAL WATER QUALITY STANDARDS, IMPOUNDMENT, W69-08213 BATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, W69-08546 PUBLIC HEALTH PACTORS IN REACTOR SITE SELECTION, CLASSIFICATION OF WATERS AND STANDARDS OF PURITY. WATER QUALITY MANAGEMENT IN VIRGINIA, W69-08554 STATE AGENCIES
PATUXENT RIVER WATERSHED.
W69-08149 REGULATION, W69-08626 STATE BOARD OF HEALTH
STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY.
W69-08186
06E UNITED STATES V STATE OF LOUISIANA (LOUISIANA BOUNDARY CASE). W69-08134 062 028 W69-08550 RELATIONS WITH PEDERAL GOVERNMENT CERTAIN STATE-OWNED STORM DRAINS -06E ROCKEPELLER V HOGUE (REMOVAL OF GAME AND PISH COMMISSIONERS). OSE W69-08185 06E BROWN V CITY OF JOLIET. W69-08177 STATE JURISDICTION
HINES AND MINERALS.
#69-08371 068 COASTAL PLAIN, W69-08439 STATISTICAL METHODS
SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS,
W69-08223
02J HYDROLOGY OF WETLAND POREST WATERSHEDS, GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, W69-08491 GENERAL REPORT SYMPOSIUM SUBJECT NEW IDEAS AND SCIENTIFIC NETHODS IN STOCHASTIC (STATISTICAL) HYDROLOGY, SOURCE AREAS OF STORE RUNOFF, WHEN IS IT SAPE TO EXTEND A PREDICTION EQUATION—AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS, 969-08509 W69-08569 024 STRATIFIED PLOW SOME APPLICATIONS OF CROSS-SPECTRAL AWALYSES IN HYDROLOGY RAINFALL AND RUNOFF, 02A 02A 02A

STEELHEAD TROUT PRODUCTION OF JUVENILE STEELHEAD TROUT IN A PRESHWATER STOCHASTIC PROCESSES
STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, PATTERNS OF SUCCESSION OF DRY AND WET TEARS AS A BASIS FOR COMPUTATIONS OF STREAMPLOW REGULATION, 469-08613 07C USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF HYDROLOGICAL PROCESSES, w69-08624 07C THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF STOMATAL INPILITATION MEASUREMENTS AS AN INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON, W69-08293 INDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, CAPITAL CANDY CO INC V CITY OF MONTPELIER (FLOOD DANAGE FROM DRAINAGE SYSTEM). STORM RUNOPP STREAMPLOW - AN IMPORTANT FACTOR IN FOREST MANAGEMENT IN THE RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND PERM-COVERED AND BURNED WATERSHEDS IN HAWAII, W69-08510 02G SELECTIVE WITHDRAWAL FROM DENSITY - STRATIFIED RESERVOIRS, W69-08419 STREAM CLEANING LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT STREAMS.

SUBJECT INDEX STR-9

¥69-08159 068 STRFAMFLOW VOLUMES AND HYDROGRAPHS BY PLUORESCENT DYES, ₩69-08480 LANDOWNERS IN YORK COUNTY TO CLEAN OUT STREAMS. W69-08158 LANDOWNERS IN CHESTER AND CHEROKEE COUNTIES TO CLEAN OUT 06E GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, W69-08264 02P AN IMPORTANT PACTOR IN POREST MANAGEMENT IN THE COASTAL PLAIN, W69-08439 PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION, W69-08479 038 BOROUGH OF WINDBER V SPADAFORA (CONSTRUCTION EXTENDING INTO NON-NAVIGABLE WATER). W69-08567 SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS, W69-08591 STREAMFLOW PORECASTING SOME PROBLEMS OF STREAMFLOW FORECASTS BASED ON INFORMATION THEORY. W69-08241 OPERATIONAL STREAMFLOW FORECASTING WITH THE SSARR MODEL, W69-08245 APPLICATION OF STREAMPLOW SYNTHESIS AND RESERVOIR REGULATION -*SSARR'--PROGRAM TO THE LOWER MEKONG RIVER, W69-0824 02E DROUGHTS IN FINNISH WATERCOURSES WITH REFERENCE TO WATER SUPPLY AND POLLUTION CONTROL (FINNISH), W69-08254 028 AREAL EXTENT OF SNOW COVER IN RELATION TO STREAMPLOW IN CENTRAL COLORADO, W69-08454 PORECASTS WITH VARYING RELIABILITY, 028 SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOFF REGULATION, GAINESVILLE STONE CO V PARKER (DAMAGE TO LAND BY FLOODING CAUSED BY IMPROPER DAM MAINTENANCE).
W69-08323 RIVERS AND STREAMS AS LAWFUL PENCES. W69-08328 06E POWER TO CROSS ROADS, HIGHWAYS AND STREAMS CROSSING CANALS OR NAVIGABLE WATERS. W69-08330 CREEKS OR RUNS WIDENING, STRAIGHTENING, ETC. COMPANISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL MOISTURE IN WATER EFFICIENCY STUDIES, W69-08292 SUBMERGED LANDS SPECIFIC GRANTS OR CESSIONS. W69-08182 068 SUBMERGED LANDS ACT
THE MARITIME BOUNDARIES OF THE STATES,
W69-08329 06E SUBSURPACE RUNOPP
RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 05D

068

SUCCESSION
SHRUB SEEDLING REGENERATION AFTER CONTROLLED BURNING AND
HERBICIDAL TREATMENT OF DENSE PRINGLE HANZANITA CHAPARBAL,

PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID REGION, W69-0849 03B

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 INFLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN METABOLISM OF BLUEGILL SUNFISH, 869-08520 SURFACE DRAINAGE BROWN V CITY OF JOLIET. W69-08177 068 SURFACE RUNOFF RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 05D SURFACE WATER CHINKING UP SOME CRACKS, W69-08539 SURFACE WATERS
AN OUTLINE OF POLAND'S HYDROGRAPHY (POLISH), W69-08253 STATE EX REL TETER \mathbf{v} STATE ROAD COMMISSION (DAMAGE ASCERTAINMENT). 040 SUGGESTIONS ON COMPILATION OF SMALL SCALE HYDROGEOLOGICAL MAPS, W69-08595 WATER RESOURCES AND DEVELOPMENT WATER RESOURCES, W69-08604 02E PRINCIPLES OF HYDROLOGY. 028 SURFACE-GROUNDWATER RELATIONSHIPS
ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID
OF ELECTRONIC COMPUTERS (FRENCH), GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, W69-08264 TRANSPER OF OXYGEN IN AQUEOUS SOLUTIONS, W69-08217 05A SURPBOARDING WATER SKIS, SURFBOARDS AND AQUAPLANES REGATTAS, ETC. W69-08156 DRAINAGE DISTRICTS UNDER 1911 ACT. W69-08152 OBA GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL FOR FIELD AND OFFICE WORK, W69-08227 SUSPENDED LOAD SOURE INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, W69-08501 DISPERSION OF SILT PARTICLES IN OPEN CHANNEL PLOW, SWAMPS IMPROVEMENT OF SWAMP LANDS. 068 W69-08196 A HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN, 969-08304 07A SYNTHETIC HYDROLOGY PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER SIMULATION PROGRAM, W69-08236 07C SYSTEMATIC SAMPLING
PRELIMINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE CREEK, ARIZONA WATERSHEDS, W69-08472 STSTEMS ANALYSIS
CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES, #69-08235 APPLICATION OF COMPUTERIZED OPERATIONS RESEARCH TECHNIQUE FOR OPTIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER PROJECT, M69-08240 OGA A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING, W69-08251 AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, N69-08256 MATHEMATICAL MODEL FOR DISSOLVED OXYGEN, 869-08532 05D 31

SUCTION LYSINETER

SUBSURFACE WATERS
UNDERGROUND GAS STORAGE.
W69-08138

SYS-TRA REVIEW OF SURFACE WATER SYSTEMS ANALYSIS ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS, W69-08537 ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, TAMARISK WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, W69-08490 03B WINDFALL GAINS FROM TRANSFER OF WATER ALLOTMENTS WITHIN THE COLORADO-BIG THOMPSON PROJECT, W69-08385 OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, TEMPERATURE METABOLISM OF ZINC-65 IN EUPHAUSIIDS, W69-08276 DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS, INPLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE GRASSES, W69-08467 A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES, W69-08469 THE EPPECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD, W69-08522 050 TEMPERATURE DISTRIBUTION
ANALYZING STEAM POWER PLANT DISCHARGES,
05B TEMPERATURE MEASUREMENT
WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION,
W69-08378
02D PLOOD PLAIN INFORMATION OF NORTH FORK OBION RIVER, HOOSIER AND GROVE CREEKS, UNION CITY, TENNESSEE. W69-08247 TERTIARY TREATMENT POTENTIAL REUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN, W69-08262 COMPLETE WATER REUSE, W69-08263 050 GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLORATORY HOLE, GARRIELD COUNTY, COLORADO, W69-0859 02P GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS, W69-08288 PRACTICAL IRRIGATION WITH SEWAGE EFFLUENT, TEXTILE WASTES WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY, W69-08552 THE COLORADO RIVER BASIN
MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE 064 THERMAL EXCHANGE COEFFICIENT

ANALYZING STEAM POWER PLANT DISCHARGES, W69-08411 05B

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS, ¥69-08417

THERMAL LOADING THERMAL DISCHARGES, W69-08413

05C

STATE OF NEW HAMPSHIRE V ATOMIC ENERGY COMM'N (EVIDENCE OF POSSIBLE THERMAL POLLUTION NOT WITHIN JURISDICTION OF AEC).

THERMAL EFFLUENT MAY CUT COST OF SHRIMP COCKTAIL. W69-08401

THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS, W69-08405 050

THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, $96.9{-}0.84\,0.6$

ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN, M69-08409

ANALYZING STEAM POWER PLANT DISCHARGES, W69-08411

THERMAL DISCHARGES,

ESTIMATING FORCED EVAPORATION FROM COOLING PONDS,

PORECASTING HEAT LOSS IN PONDS AND STREAMS, W69-08415

CONDITIONS FOR COEXISTENCE OF AQUATIC COMMUNITIES WITH THE EXPANDING NUCLEAR POWER INDUSTRY, W69-08420 05C

THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS, $\mbox{W}\,69-08422$

THERMAL DISCHARGES REQUIRE ADVANCE PLANNING, W69-08564

A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, 469-08519 05C

LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL, W69-08611

THERMAL POWER PLANT
THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS, W69-08405

THERMAL POWER PLANTS ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN, w69-08409

THERMAL POWERPLANTS WARM-WATER IRRIGATION AN ANSWER TO THERMAL POLLUTION,

THERMAL DISCHARGES REQUIRE ADVANCE PLANNING, W69-08564 05C

A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, W69-08599 05C

THERMAL STRATIFICATION SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SNOW COVER, W69-08451

THERMISTOR A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES, W69-08469

THREE MILE BELT
UNITED STATES V LOUISIANA (SUIT BY PEDERAL GOVERNMENT
AGAINST STATE TO DETERMINE CONTROL OF AREA OUTSIDE 3 MILE BELT). W69-08597

VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE 02 B W69-08309

THUNNUS GERMO AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM, W69-08271

THYSANOESSA SPINIFERA METABOLISM OF ZINC-65 IN EUPHAUSIIDS,

TIDAL WATERS. W69-08343

04A

RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE LOWER FLORIDA KEYS, w69-0857 02L

TIME SERIES ANALYSIS
SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY
RAINFALL AND RUNOPP,
#69-08572
02A

TOPOGRAPHY RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE NETWORKS

TRACE ELEMENTS
FE, MM, NI, CO, SR, LI, ZN, AND SILICA IN STREAMS OF THE LOWER KANSAS RIVER BASIN,

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE ANCHOYY (ANCHOA LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA PLABELUM LABOUROUX), 050

TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS,

050 ¥69-08528

NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES,

TRANSHISSIVITY
INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND
HULTILEVEL OPTIMIZATION,
W69-08550 02P

TRANSPIRATION
SURFACE RESISTANCE OF CROP CANOPIES,
W69-08573

TRANSPIRATION CONTROL
ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, W69-08210 020

TRANSPORTATION CONSTRUCTION AND MAINTENANCE OF BRIDGES. 869-08170

FLOATING TIMBER AND DAMAGE THEREFROM.

TREATMENT PACILITIES
SEWERAGE AUTHORITIES LAW.
W69-08313

THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A PLANT SITE, W69-08553

WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, \$169-08556

TRENT RIVER
ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE MOLLUSCS
PROM THE LOWER TRENT AND NEUSE RIVERS,
M69-08527 05C

TRESPASS
CAPITAL CANDY CO INC V CITY OF MONTPELIER (FLOOD DAMAGE FROM DRAINAGE SYSTEM). W69-08176 068

TRESPASSING ON PRIVATE DOCKS. 06 E

TRICKLING FILTERS
WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556

TUCSON BASIN
WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., W69-08299

INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIABID BASIN ARIZONA, U.S.A., W69-08300 02F

TURBULENT FLOW EROSIONAL CURRENT MARKS OF WEAKLY COHESIVE MUD BEDS, W69-08579

UNCERTAINTY ANALYSIS
THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS, ¥69-08266

UNDERGROUND STORAGE UNDERGROUND GAS STORAGE. #69-08138

06E

UNIFORM FLOW
A MONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND CANALS,
W69-08398
08B

UNITED STATES
EROSION AND SEDIMENTATION,
W69-08507 0.2.1

UNSTEADY FLOW
UNSTEADY FLOW IN A RESERVOIR-CONDUIT SYSTEM,
W69-08202 08B

PROPAGATION OF PLOOD WAVES IN OPEN CHANNELS,

GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS,

URBANIZATION PUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT MO 1, REQUIREMENTS AND SOURCES, U69-08257

US PUBLIC BEALTH SERVICE STATE BOARD OF HEALTH, RAILROADS, WATER AND ICE SUPPLIES. W69-08187 06E

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMFLOW REGULATION, U69-08612

UTILITIES
PUBLIC WORKS AUTHORIZED UNDER ARTICLE.
W69-08179 04A

HACKENSACK WATER COMPANY V VILLAGE OF MYACK (ACTION TO RECOVER FOR WITHDRAWAL LOSS). W69-08312

VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE SOUTHWEST.

AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN OPERATION OF A SYSTEM OF DAMS,

PORECASTS WITH VARYING RELIABILITY,

SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS, 969-08591

VARIABLE COSTS
DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, ¥69-08295

VEGETATION
POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN
WESTERN STATES WITH EMPHASIS ON CALIFORNIA,
W69-08308
O2D

GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, W69-08491 03B

VEGETATION EPPECTS
SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, ARIZONA, W69-08474 Oan

POSSIBILITIES OF INCREASING STREAMFLOW FROM FOREST AND RANGE WATERSHEDS BY MANIPULATING THE VEGETATIVE COVER--THE BEAVER CREEK PILOT WATERSHED EVALUATION STUDY, 03B

VELOCITY AN EXAMPLE OF DAMAGE PROM A POWDER AVALANCHE,

VELOCITY CONSTANTS
BIOLOGICAL OXIDATION RATES IN HIME ACID WATER REGIMES,
05G W69-08379

VENEZHELA SURFACE-WATER INFILTRATION AND GROUNDWATER HOVEMENT IN ARID ZONES OF VENEZUELA, W69-08306

VERMONT WATERSHED PROTECTION AND PLOOD PREVENTION. W69-08150

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMPACT. W69-08151

SEASONS, WATERS, LIMITS. W69-08168

PROPAGATION AND CONTROL OF FISH AND WILD ANIMALS. W69-08169

CAPITAL CANDY CO INC V CITY OF HOSTPELIER (FLOOD DAMAGE FROM DRAINAGE SYSTEM). 06E

PISH CONSERVATION RULES AND REGULATIONS. 06E

CAMPBELL W STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDENNATION OF A SPRING AND AN EASEREMY). 0.0.0.

FLOOD PLAIN INFORMATION, UPHAN BROOK, HENRICO, WIRGINIA. W69-08610

VIRUSES
THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS, W69-08621
05D

RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON,

WARHED WATER
AN INVESTIGATION INTO THE EFFECTS OF WARNED WATER FROM MARCHMOOD POWER STATION INTO SOUTHARPTON WATER,

WARMED WATER DISCHARGE
AN INVESTIGATION INTO THE EFFECTS OF WARMED WATER FROM
MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER,
W69-08408
05C

WASTE ASSIMILATIVE CAPACITY
FORECASTING HEAT LOSS IN POUDS AND STREAMS,
W69-08415
05B

WASTE TREATMENT A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.

WAS-WAT M69-08199 MATHEMATICAL MODEL FOR DISSOLVED OXYGEN WASTE WATER DISPOSAL REUSE CAN BE CHEAPER THAN DISPOSAL, 050 W69-08260 WARM-WATER IRRIGATION AN ANSWER TO THERMAL POLLUTION, WASTE WATER TREATHENT TREATHENT OF HIGH NITRATE WATERS, W69-08228 OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORATORY, W69-08534 RENOVATION OF WASTE WATER THROUGH APPLICATION TO RENOVATION OF WASING AND FORESTLAND,

AGRICULTURAL CROPLAND AND FORESTLAND, WATER YIELDS RESULTING FROM TREATMENTS APPLIED TO MIXED CONIFER WATERSHED, W69-08477 WATER ANALYSIS A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL. DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRATION, W69-08559 WATER BLOOM LAKE TERMINOLOGY WATER BLOOM, W69-08279 05C WATER CHEMISTRY

A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER
POLLUTION CONTROL. FF. MM. NI, CO. SR. LI, ZN. AND SILICA IN STREAMS OF THE LOWER KANSAS RIVER BASIN, W69-08204 PLANT NUTRIENTS IN BASE FLOW OF STREAMS IN SOUTHWESTERN SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CABBONATE SEDIMENTATION THEIR IMPLICATION ON DIAGENESIS, DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SHALL WATERSHED, N69-08234 07C PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN THE RED SEA, W69-08581 WATER CONSERVATION AND IRRIGATION CORPORATION. W69-08129 ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, W69-08210 0.2D CONSERVATION OF WATER. W69-08334 04 A WATER CONTROL PLOOD CONTROL PROJECTS. W69-08167 '06R STATE HIGHWAY DEPARTMENT, COST SHARING IN HIGHWAY PROJECTS. W69-08338 STATE V BENTLEY (WATER DAMAGE). 06 E

WATER COOLING
WATER USE AND RELATED COSTS WITH COOLING TOWERS,
#69-08407

WATER COSTS
REUSE CAN BE CHEAPER THAN DISPOSAL,
W69-08260

WATER DEHAND
FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION.
REPORT NO 1, REQUIREMENTS AND SOURCES,
W69-08257
06D

WATER DISTRIBUTION(APPLIED)
LOCAL PROVISIONS.
W69-08155

05G

WATER DISTRICTS
LOCAL PROVISIONS.
W69-08155

05G

KOSTON V TOWN OF NEWBURGH (WATER DISTRICT ASSESSMENT). W69-08367

WATER EFFICIENCY STUDIES
COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL
MOISTURE IN WATER EFFICIENCY STUDIES,
M69-08292
02D

WATER FIELD IMPROVEMENT
OBSERVATIONS OF SNOWPACK ACCUMULATION, MELT, AND RUNOFF ON A
SMALL ARIZONA WATERSHED,
W69-08493
03B

POSSIBILITIES OF INCREASING STREAMPLOW FROM POREST AND RANGE WATERSHEDS BY MANIPULATING THE VEGETATIVE COVER--THE BEAVER CREEK PILOT WATERSHED EVALUATION STUDY, 03B

WATER INJURY

BRASWELL V STATE HIGHWAY AND PUBLIC WORKS COMM®N (WATER DAMAGE FROM DIVERSION).

M69-08311

04C

WATER LAW REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION, W69-08391 068

WATER LEVELS
DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, W69-08242
07C

WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--- 1968, W69-08588 02F

WATER LOSS
NET LOSSES IN SPRINKLER IRRIGATION,
W69-08305
038

WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, W69-08490

WATER MANAGEMENT REGULATION OF WATER RESOURCES. W69-08360 04A

ESTINATING FORCED EVAPORATION FROM COOLING PONDS, W69-08414

WATER MANAGEMENT(APPLIED)
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF
ENGINEERS IN GEORGIA.
W69-08225
04A

CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES, W69-08235 048

FUND FOR WATERWAY IMPROVEMENT PROJECTS IN CHARLES COUNTY BUILDING ACROSS NAVIGABLE RIVER PROHIBITED. 469-08331 06E

SOUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING COMMITTEE. W69-08359 06E

INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, 469-08550 02F

WATER QUALITY MANAGEMENT IN VIRGINIA, W69-08554 05G

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ALABAMA. 469-08600 08A

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN IDAHO.

W69-08601 08A

WATER RESOURCES DEVELOPMENT BY THE U.S. ARBY CORPS OF ENGINEERS IN ARKANSAS. W69-08602 08a

WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF ENGINEERS IN INDIANA. W69-08603 OSA

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMFLOW REGULATION, W69-08612 07C

WATER POLICY
WATER POLLUTION CONTROL.
W69-08127

05G

PLOOD CONTROL PROJECTS. W69-08167

068

HETROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION). W69-08172

PLOWAGE. W69-08354 O4A DAHS IN DISREPAIR AND CHANNEL IMPROVEMENT. WAT-WAT

SUBJECT INDEX BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR, 048 W69-08361 W69-08563 SATER POLITICAL HARBORS AND PUBLIC WATERS. W69-08197 06E AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN. W69-08220 SEWERAGE AUTHORITIES LAW-W69-08313 0.5G EFFECT OF A WATERSHED TREATHENT WITH PICLORAM ON WATER QUALITY, W69-08484 05 B WATER POLLUTION CONTROL WATER POLLUTION CONTROL. W69-08127 NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMPACT. METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO V UNITED STATES STEEL CORPORATION (INDUSTRIAL WATER POLLUTION). 969-08172 CLASSIFICATION OF WATERS AND STANDARDS OF PURITY. POLLUTION CONTROL AUTHORITY OF SOUTH CAROLINA. PEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS, W69-08555 WATER POLLUTION EFFECTS
ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HIDROXY-2HETHYLBORBANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL ACTINOMYCETES, 869-08219 NATURAL AND POLLUTION SOURCES OF IODINE, BRONINE, AND CHLORINE IN THE GREAT LAKES, W69-08562 A SYSTEMS ANALYSIS OF AQUATIC THERNAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, W69-08599 LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL, W69-08611 Q5C WATER POLLUTION SOURCES SENAGE DISPOSAL SYSTEMS HEAR SHORELINES. W69-08154 PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION, SOME EFFECTS OF PESTICIDES ON MISSISSIPPI WATERS, WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY, W69-08552 STATE BOARD OF HEALTH, RAILROADS, WATER AND ICE SUPPLIES. W69-08187 A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL. W69-08199 REGIONAL WATER QUALITY STANDARDS, #69-08213 05G RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SHALL WATERSHED, #69-08234 BETURN FLOWS A REUSABLE WATER RESOURCE, W69-08259 05D PROTECTING WATER AND ICE SOURCES. W69-08350 05G 056 W69-08351 WATER ALLOCATION SUPPLY AND DEBAND RELATIONSHIPS, WATER QUALITY AS AFFECTED BY A SYMMING HOUSTAIN BOG, \$69-08455 05B WATER QUALITY HANAGEHENT IN VINGINIA, W69-08554 05G

BETTER MANAGEMENT OF WATER RESOURCES IS A BUST IF FUTURE NEEDS ARE TO BE MET. W69-08557

MATURAL AND POLLUTION SOURCES OF IODINE, BROKINE, AND CHLORINE IN THE GREAT LAKES, W69-08562

PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN THE RED SEA, W69-08581 WATER QUALITY ACT REGIONAL WATER QUALITY STANDARDS, W69-08213 056 AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN. FEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS, W69-08555 05G WATER QUALITY CONTROL STATE BOARD OF HEALTH ¥69-08166 STATE BOARD OF HEALTH, FOOD PROCESSING LAWS, WATER SUPPLY. W69-08186 AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN. W69-08220 PROTECTING WATER AND ICE SOURCES. W69-08348 SOUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING COMMITTEE. #69-08359 A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, W69-08542 WATER QUALITY MANAGEMENT IN VIRGINIA, W69-08554 05G WATER REQUIREMENTS
HOISTURE USE BY FORAGE SPECIES AS RELATED TO PAN EVAPORATION
AND NET RADIATION,
W69-08432
021 WATER RESOURCES GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESE), W69-08248 GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, W69-08264 GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS, W69-08288 REGULATION OF WATER RESOURCES. REVIEW OF SURFACE WATER SYSTEMS ANALYSIS W69-08533 OPERATIONS RESEARCH ACTIVITIES AT CINCINSATI WATER RESEARCH LABORATORY, W69-08534 ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, $969\!-\!08543$ STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, W69-08546 THE ECONOMICS OF CLEAN WATER, 05% W69-085#8 BETTER HANAGEMENT OF SATER RESOURCES IS A HUST IF FUTURE HEEDS ARE TO BE MET, W69-08557 056 WATER RESOURCES AND DEVELOPMENT WATER RESOURCES, W69-08604 WATER RESOURCES BOARD FLOOD CONTROL PROJECTS. W69-08167 06 E EXCAVATING AND DREDGING IN PUBLIC WATERS. #69-08342 HATER RESOURCES DEVELOPMENT MISSISSIPPI WATER RESOURCE COMPERENCE -WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN GEORGIA. 04A A REVIEW OF SOME APPLICATIONS OF NATHENATICAL PROGRAMMING IN WATER RESOURCES EMGINEERING, 063 INVESTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS, N69-08266 W69-08256

WATER RIGHTS
CAMPBELL V STATE HIGHWAY COMMISSIONER (COMPENSATION FOR CONDEMNATION OF A SPRING AND AN BASEMENT). OUTH CAROLINA WATER RESOURCES PLANNING AND COORDINATING 06E NORTH AMERICAN WATER SUPPLY PROBLEMS AND THEIR SOLUTION, 69-09380REGIONAL ECONOMIC DEVELOPMENT AND WATER W69-08387 NEEDS ARE TO BE MET, W69-08557 PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, W69-08487 WATER SOURCES PROTECTION OF WATER SUPPLY. W69-08195 WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ALABAMA. W69-08600 WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN IDAHO. W69-08259 WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARKANSAS. W69-08602 08A W69-08350 WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF FINGINEERS IN INDIANA. W69-08351 W69-08603 WATER RESOURCES ENGINEERING
A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING, W69-08251 AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, W69-08285 WATER RESOURCES PLANNING ACT NORTH AMERICAN WATER SUPPLY PROBLEMS AND THEIR SOLUTION, W69-08380 068 WATER STRUCTURE BETTER MANAGEMENT OF WATER RESOURCES IS A MUST IF FUTURE NEEDS ARE TO BE MET, W69-08557 W69-08560 WATER SUPPLY WATER RESOURCES REGIONAL AGRICULTURAL ANALYSIS AND PPOJECTIONS SYSTEM DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER W69-08389 10 SUPPLIES, W69-08282 RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, #69-08215 05D INTERSTATE WATER COMPACT. RETURN FLOWS A REUSABLE WATER RESOURCE, W69-08259 REUSE CAN BE CHEAPER THAN DISPOSAL, W69-08349 WATER REUSE IN SPACE, W69-08261 W69-08351 05D POTENTIAL REUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN, WITH WATER SUPPLY BY CITY). W69-08355 COMPLETE WATER REUSE. 05D WATER REUSE IN MONTERREY, MEXICO, W69-08406 WASTEWATER REUSE AT THE GRAND CANYON, W69-08290 05 D W69-08535 MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION. W69-08615 MISSOURI RIVER BASIN. W69-08605 SOIL RESPONSE TO SEWAGE EFFLUENT IRRIGATION, W69-08616 CROP RESPONSE TO SEWAGE EFFLUENT, W69-08617 ARIZONA, U.S.A., W69-08299 SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION, W69-08618 PRACTICAL IRRIGATION WITH SEWAGE EFFLUENT, GROUNDWATER RECHARGE WITH TREATED HUNICIPAL EFFLUENT, WATER TEMPERATURE THE HOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS, ¥69-08621 A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION, W69-08623 AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIPER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, 05D

WATER SHORTAGE
TREATING WASTES IN A WATER-SHORT AREA,
05D BETTER MANAGEMENT OF WATER RESOURCES IS A MUST IF PUTURE FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT NO 1, REQUIREMENTS AND SOURCES, $\$69{-}08257$ A REUSABLE WATER RESOURCE PROTECTING WATER AND ICE SOURCES. 05G MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION WATER STORAGE
EPPECT OF HEAVY LATE-FALL PRECIPITATION ON RUNOFF FROM A CHAPARRAL WATERSHED, HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, 02G OBSERVED DIPPRACTION PATTERN AND PROPOSED MODELS OF LIQUID FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT NO 1, REQUIREMENTS AND SOURCES, PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER 06E PROTECTING WATER AND ICE SOURCES. W69-08348 05G GOLDIN V TRUSTEES OF VILLAGE OF ELLENVILLE (INTERPEBENCE WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS, \$69-08390THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, AN APPLICATION OF WON-LINEAR PROGRAMMING TO THE PLANNING OF MUNICIPAL WATER SUPPLY SYSTEMS SOME RESULTS, w60-0855 06A $\,$ SURPACE WATER SUPPLY OF THE UNITED STATES, 1961-65 PART 6. WATER TABLE
WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN WATER TABLE, SOIL MOISTURE, AND OXIGEN DIPPUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, W69-08490 03B WATER QUALITY MANAGEMENT IN VIRGINIA, W69-08554 STATE BOARD OF HEALTH WATER. W69-08166 TRANSPER OF OXYGEN IN AQUEOUS SOLUTIONS, W69-08217 05A THE USE EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-08429 02D SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN

W69-08260

WATER REUSE PROCESSING COSTS
REUSE CAN BE CHEAPER THAN DISPOSAL,

WATERSHED VARIABLES

	DLURADO, 59-08468	021
ATE	ER UTILIZATION	
We	DNSERVATION OF WATER. 59-08334	0 4 A
C	UMMER WATER USE BY ASPEN, SPRUCE, AN OLORADO, 69-08468	D GRASSLAND IN WESTERN 021
WAT	ER WELLS EOLOGY AND HYDROLOGY OF THE PROJECT	RULISON EXPLORATORY
H	OLE, GARFIELD COUNTY, COLORADO, 69-08596	02F
WAT	ER YIELD RELIMINARY WATER YIELDS AFTER TIMBER	HARVEST ON CASTLE
C	REEK, ARIZONA WATERSHEDS, 69-08472	03В
	HE WORKMAN CREEK EXPERIMENTAL WATERS	HED, 03B
P	ROSION AND SEDIMENT MOVEMENT POLLOWING ONDEROSA PIME FOREST OF CENTRAL ARIZ	NG A WILDPIRE IN A CONA, O4D
P	MPORTANT WATERSHED CHARACTERISTICS A LOOD PEAKS AND EROSION AND SEDIMENTA HEPDED FOR PRODUCTION, 69-08508	PPECTING WATER YIELD, TION AND THE BASIC DATA
	THE REPORT OF THE PART OF THE	
W	MATER YIELD CHANGES AFTER CONVERTING SRASS, 169-08200	A FORESTED CATCHMENT TO
	THE WORKMAN CREEK EXPERIMENTAL WATERS	SHED, 03B
5	WATER VIELDS RESULTING FROM TREATMENT	TS APPLIED TO MIXED
5	CONIFER WATERSHED, #69-08477	03B
	WATERSHED TREATMENT EFFECTS ON EVAPO	TRANSPIRATION, 02D
(IMPROVING WATER YIELD AND GAME HABIT. DF CHAPARRAL, W69-08483	O3B
	BURNED CHAPARRAL TO GRASS EARLY EF SEDIMENT YIELDS FROM TWO GRANITIC SO	PECTS ON WATER AND
	ARIZONA, W69-08485	03B
	OBSERVATIONS OF SNOW ACCUMULATION AN CUTTINGS OF PONDEROSA PINE IN CENTRA W69-08494	D MELT IN DEMONSTRATION L ARIZONA, 03B
	MANAGING CALIFORNIA'S SNOW ZONE LAND W69-08498	S FOR WATER, 03B
	FORESTS USERS OF WATER, W69-08512	03B
WA	TERFOWL	
	SUSQUEHANNA FLATS. W69-08492	06E
WA	TERSHED MANAGEMENT PATUXENT RIVER WATERSHED. #69-08147	06E
	w69-08148	06E
	W69-08149	06E
	PRELIMINARY WATER YIELDS AFTER TIMB	ER HARVEST ON CASTLE
	CREEK, ARIZONA WATERSHEDS, W69-08472	03B
	WATERSHED TREATMENT EFFECTS ON EVAPORED W69-08481	0.20
	OBSERVATIONS OF SHOWPACK ACCUMULATION SHALL ARIZONA WATERSHED, W69-08493	ON, MELT, AND RUNOFF ON
	OBSERVATIONS OF SHOW ACCUMULATION A CUTTINGS OF PONDEROSA PINE IN CENTR #69-08494	03B
	POSSIBILITIES OF INCREASING STREAMF WATERSHEDS BY MANIPULATING THE VECE CREEK PILOT WATERSHED EVALUATION ST W69-08495	TWITAR COARD IND DOUGH
	MANAGING CALIFORNIA'S SNOW ZONE LAN W69-08498	DS FOR WATER, 03B
	INTEGRATING SNOW ZONE HANAGEHENT WI	TH BASIN MANAGEMENT,
	PAINFALL AND STREAMPLOW PROM SMALL COVERED AND BURNED WATERSHEDS IN HAW69-08510	TREE-COVERED AND FERM- WAII, 02G
	FORESTS USERS OF WATER, W69-08512	038

```
ATTERSHED VARIABLES
IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD,
FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE EASIC DATA
NEEDED FOR PRODUCTION,
W69-08508
04D
WATERSHEDS(BASINS)
PATUXENT RIVER WATERSHED.
W69-08147
   IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD, PLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION,
WATERSKIING WATER SKIS, SURPBOARDS AND AQUAPLANES REGATTAS, ETC. W69-08156 OGE
WATER-BLOOM
THE "WORKING" OF THE MADISON LAKES,
W69-08283
WATER-LEVEL FLUCTUATIONS DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, W69-08242
WATER-RELEASE CURVES
WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY
   PLANTS,
W69-08302
                                                              03F
WAVES(WATER)
PROPAGATION OF FLOOD WAVES IN OPEN CHANNELS,
    W69-08590
 WEATHER DATA
ON A METHOD OF FLOOD FORECASTING USING A DIGITAL COMPUTER
CONNECTED WITH A WEATHER RADAR,
 WEATHER PORECASTING
COMPUTATIONAL ANALYSES OF MOISTURE PLUX OVER NORTH AMERICA,
028
    DETRIMENTAL EPPECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN WEST-CENTRAL NEW MEXICO,
     W69-08464
 WEST VIRGINIA
WILDLIPE MANAGEMENT.
W69-08326
                                                               068
    POWERS AND DUTIES OF CONSERVATION OFFICERS. W69-08327
    RIVERS AND STREAMS AS LAWFUL FENCES. W69-08328
    STATE EX REL TETER \mathbf{v} STATE ROAD COMMISSION (DAMAGE ASCERTAINMENT).
     ₩69-08375
  WESTERN DESERT GROUND WATER OF THE WESTERN DESERT IN IRAC, w69-08298
     FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN, W69-08437
     HYDROLOGY OF WETLAND POREST WATERSHEDS,
     SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, 04A
     LEGISION AND SEDIMENT NOVEMENT POLLOWING A WILDFIRE IN A PONDEROSA PINE FOREST OF CENTRAL ARIZONA, N69-08475
   WILDLIFE
      GAME AND FISH.
W69-08141
      POSSESSION AND TRANSPORTATION OF PROTECTED GAME AND FISH. W69-08142 \,
      POLICE POWER AND DUTIES OF TRE COMMISSIONER OF COMSERVATION.
      PROPAGATION AND CONTROL OF FISH AND WILD ANIHALS.
   WILDLIFE CONSERVATION
POWERS AND DUTIES OF CONSERVATION OFFICERS.
W69-08327
06E
   WILDLIFE CONSERVATIONS WILDLIFE MANAGEMENT. W69-08326
   WILDLIFE HABITATS
GAZING IN RELATION TO RUNOFF AND EBOSION ON SOME CHAPARRAL
                                                                                                37
```

WATER:	SHEDS	OF	CENTRAL	ARIZONA
	01.20			

040

WILDLIFE MANAGEMENT
KREP MAINE SCENIC ALLAGASH PIVFR AUTHORITY.
W69-08131 06E

POSSESSION AND TRANSPORTATION OF PROTECTED GAME AND FISH.

WINDPALL GAINS FROM TRANSFER OF WATER ALLOTMENTS WITHIN THE COLORADO-BIG THOMPSON PROJECT,
269-08785 068

WINDS
WIND DAMAGES IMPROPERLY PLANTED SLASH PINE,

THE WPATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES, $$\rm W69\text{--}08448$

WISCONSIN
BALDWIN Y ANDERSON (TITLE TO LAND FORMED BY AVULSION OF ACCEPTION).
W69-08191
06E

PLANT NUTRIENTS IN BASP PLOW OF STRPAMS IN SOUTHWESTERN WISCONSIN, M69-04205

LUPNING V PUBLIC SERVICE COMMISSION (PERMIT TO CONSTRUCT HYDROFLECTRIC DAM).
869-08319
8C

WITHDRAWAL HACKENSACK WATER COMPANY V VILLAGE OP NYACK (ACTION TO PECOVER FOR WITHDRAWAL LOSS).
W69-08312 04C

SFLECTIVE WITHDRAWAL FROM DENSITY - STRATIFIED RESERVOIPS, w69-08419

WYOMING
FLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPRR, WYOMINGVOLUME 1.
W69-08224
04a

X-BAY DIFFRACTION
OBSERVED DIFFRACTION PATTERN AND PROPOSED MODELS OF LIQUID WATER,
M69-08560
01A

YEASTS
SURVIVAL AND ACTIVITY OF SEWAGE MICPOORGANISMS IN ACID MINE WATER,
W69-08400
05D

YPLLOW BASS
FOOD HARITS OF THE YELLOW BASS, ROCCUS MISSISSTPPIENSIS,
CLEAR LAKE, IOWA, SUMMER 1962,
W69-08515
05C

YIELD
PRODUCTION OF JUVENILE STEELHEAD TROUT IN A PRESHWATER INPOUNDMENT,
869-08517
02H

YORK COUNTY TO CLEAN OUT STREAMS. N69-08158 OGE

ZINC RADIOISOTOPES
INPLUENCE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF
ZN-65 BY AN EXPERIMENTAL COMMUNITY,
W69-08267
05C

THE CONCENTRATION OF ZN-65 BY OTSTERS MAINTAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT, W69-08268 05C

RADIOZINC DECLINE IN STARRY PLOUNDERS APTER TEMPORARY SHUTDOWN OF HANFORD REACTORS, W69-08270 05C

TRANSPER OF 2N-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN, $_{\rm W69-08273}$

THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, w69-08274 05C

A COMPARISON BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA, W69-08275

METABOLISM OF ZINC-65 IN EMPHAUSIIDS, W69-08276 05C

THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIPLORA IN CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD CHAINS, #69-04277 05C

ELIMINATION OF TODINE, COBALT, IRON, AND ZINC BY MARINE ZOOPLANKTON, W69-08523 05C

ZINC-65 IN ECHTNODERMS AND SEDIMENTS IN THE MARINE ENVIRONMENT OFF OREGON, W69-08531 05C

ZONING
AIRCRAPT UNDERGROUND GAS STORAGE.
W69-08137
06

ZOOPLANKTON ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE ZOOPLANKTON, $${\rm M6}\,{}^{\rm Q}\!-\!08523$

ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON, W69-08529 05C

2-4-D
SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGPBRUSH WITH 2, 4-D,
W69-08460
021

2-4-5-T
HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND
BIRCHLEAP MOUNTAINMAHOGANY,
M69-08486 . 03B

'WORKING' OF LAKES
THE 'WORKING' OF THE MADISON LAKES,
W69-08283 02H

AUTHOR INDEX

- APDEL PAHMAN, A. A. WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS, #69-08303 03P
- AHLERT, ROBERT C.
 DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS, W69-08394 05C
- ALDON, FARL F.
 MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE PONDEROSA PINE STANDS,
 W69-08461
 02G
 - SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SPHIDESERT RANGES,
 - DEPERRED GRAZING AND SOIL RIPPING IMPROVES FORAGE ON NEW MEXICO'S RIO PUERCO DRAINAGE, 969-08463 044
 - DETRIMENTAL EFFECT OF RUSSIANTHISTLE ON SEMIDESERT RANGE IN WEST-CENTRAL NEW MEXICO, 02G
- ALLEN, J. R. L. EROSIONAL CURRENT MARKS OF WEAKLY CORRSIVE MUD BEDS, 869-08579 02J
- ALSPAUGH, T. A. WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 05D
- ALTOUNEY, EDWARD G.
 THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS,
 068
- AMAPTIESET, R.
 SOMF REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS, W69-08232
- AMISIAL, ROGER A.
 A DIGITAL COMPUTER PROGRAM TO PLOT ISOMYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION,
 469-08238 07C
- ANDERSON, HENRY W.

 PRODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWATI, AS
 RELATED TO SOIL FORMING FACTORS,
 1049-08407

 02J
 - AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK DESIGN, 07A
 - MANAGING CALIPORNIA®S SNOW ZONE LANDS FOR WATER, #69-08498
 - SNOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN MET AND DRY YEARS, #69-08500 02C
 - SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, $$02\lambda$$
 - SUBMARY OF FORESTS AND SOIL STABILIZATION SESSION, M69-08502
 - INTEGRATING SHOW ZONE MANAGEMENT WITH BASIN MANAGEMENT, W69-08503
 - WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, 02a
 - GENERAL REPORT SYMPOSIUM SUBJECT HEW IDEAS AND SCIENTIFIC HETHODS IN STOCHASTIC (STATISTICAL) HYDROLOGY, W69-08505
 - SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, W69-08506
 - EBOSION AND SEDIMENTATION, W69-08507
 - IMPORTANT WATERSHED CHARACTERISTICS APPECTING WATER TIELD, FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA MEEDED FOR PRODUCTION, 04D

02J

- COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SHALL GROUPS OR INDIVIDUALS, W69-08511
- ANDERSON, R. W.
 RAINFALL AND STREAMFLOW FROM SMALL TREE-COVERED AND FERNCOVERED AND BURNED WATERSHEDS IN HAWAII,
 02G
- AMDERSON, RAYMOND L.
 WINDPALL GAINS FROM TRANSFER OF WATER ALLOTHENTS WITHIN THE
 COLORADO-BIG THOMPSON PROJECT,
 459-08185
 06B

- ANDING, WARREN G.
 AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIVER, W69-08399

 06G
- ANGINO, ERNEST E.
 SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITANS AND S
 NATAWS,
 1509-0520 050
- ANGINO, E. E.
 FE, MN, NI, CO, SR, LI, ZN, AND SILICA IN STREAMS OF THE LOWER KANNAS RIVER BASIN,
 W50-08704
 05A
- ARMSTRONG, R. W. WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY, \$W69-08552\$
- ARNER, DALE H.

 AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA
 RIVER,
 066
- ASHLEY, D. A.
 SOIL HOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION
 FROM WARM SEASON PERENNIAL FORAGE SPECIES,
 469-08426
 02D
 - EVAPOTRANSPIRATION BY IRRIGATED CORN,
 - EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-08429
 - EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON, M69-08430
 - MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, 02D
 - MOISTURE USE BY FORAGE SPECIES AS RELATED TO PAN EVAPORATION AND NET RADIATION, W69-08432
 - EFFECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON HOISTURE USE AND YIELD OF CORN, W69-08434
- ASKEW, ARTHUR J.
 LAG TIME OF NATURAL CATCHMENTS,
 W69-08250 02
- BAGHDADI, ABBAS IHSAN GROUND WATER OF THE WESTERN DESERT IN IRAQ, W69-08298 03C
- BAILEY, R. G.
 SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN
 SOUTHERN CALIFORNIA,
 W69-08201
 02G
- BAPTIST, JOHN P.
 TRANSPER OF 2N-65 AND CR-51 THROUGH AN ESTUARINE FOOD CHAIN, W69-08273
- BARBARO, R. D.

 BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS
 IN THE ROSS BARNETT RESERVOIR,

 W69-08563

 05B
- BARNHART, EDWIN L. TRANSFER OF OXYGEN IN AQUEOUS SOLUTIONS, W69-08217 05A
- BATA, GAZA L. RECIRCULATION OF COOLING WATER IN RIVERS AND CAMALS, 869-084-16
- BEARD, LEO R.
 HYPOTHETICAL FLOOD COMPUTATION FOR A STREAM SYSTEM,
 #69-08239 07C
 - ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS, W69-08543
- BECKETT, F. E.
 A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION, W69-08623
- BENNETT, E. O.
 OLEFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,
 W69-08284
 OSA
- BENNETT, ORUS L-EPPECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOL-SEASON FORAGE SPECIES, M69-08425
 - YIELD AND BINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL HOISTURE, 021

BENNETT, O. L.
SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION
FROM WARM SEASON PERENNIAL FORAGE SPECIES,
UKG-08026

EFFECTS OF SOIL MOISTURE REGIME ON YIRLD AND EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE SPECIES.

EVAPOTRANSPIRATION BY IRRIGATED CORN,

EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-08429 O2D

EFFECT OF MOISTURE REGIME AND STAGR OF PLANT GROWTH ON MOISTURE USE BY COTTON, $$\omega 69\!-\!08430$

MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, W69-08431

MOISTURE USE BY FORAGE SPECIES AS RELATED TO PAN EVAPORATION AND MET RADIATION, w69-00442 021

EFFECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON MOTSTURE USE AND YIELD OF CORN, W69-08434 02I

BERGEN, JAMES D.
SOMP OBSERVATIONS ON TEMPERATURE PROPILES OF A MOUNTAIN SNOW
COVER,
#69-08451
02C

ATMOSPHERIC HUMIDITY MEASUREMENT NEAR THE SNOW SURFACE,

SOME MEASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW COVER,

RERG, BRIAN WATER USE AND RELATED COSTS WITH COOLING TOWERS, $\chi 69-0.84407$

BERNHARD, M.
A COMPARISON BPTWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA, W69-08275 05C

BETSON, POGER P.
SOURCE AREAS OF STORM RUNOFF,
W69-08569

BIGURIA, GABRIEL
DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS, W69-08394 05C

028

BINGHAM, C. REX SOME EPPECTS OF PESTICIDES ON MISSISSIPPI WATERS, #69-08222 05c

BLANCHARD, BRUCE
A PIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM, W69-08544

06A

BLOKHINOV, YE G.

GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMPLOW REGULATION, W69-08612 07C

BOCH, P. COMPUTATIONAL ANALYSES OF MOISTURE FLUX OVER NORTH AMERICA, W69-08244 02B

BODY, K.

SOME PROBLEMS OF STREAMPLOW PORECASTS BASED ON IMPORMATION THEORY,
W69-08201

BOWER, BLAIR T.
SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES
PIELD,
W69-08381

BRADY, DEREK K.

THE VARIATION OF WATER TEMPFRATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS,
W69-08405
05C

BREESE, WILBUR P.
EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-WATER FISHES,
W69-08516
05C

BREZONIK, PATRICK L.
NITROGEN PIXATION IN SOME AMOXIC LACUSTRINE ENVIRONMENTS, 869-08280 02H

BROOKS, NORMAN H.
SELECTIVE WITHDRAWAL PROM DENSITY - STRATIFIED RESERVOIRS,
W69-08419 05C

NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS, W69-08424

BROWN, H. E. SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN COLORADO,

RROWN, J. L., JR.
WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION,
W69-08556
05D

BRUSH, ROBERT O.
A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, #69-08599 05C

BURAS, NATHAN
A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN
WATER RESOURCES ENGINEERING,
W69-08251
06A

AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING,

BURDON, DAVID J.
GROUNDWATER POTENTIAL OF KARST AQUIPERS IN SAUDI ARABIA, W69-08296 02F

BURKE, KEYIN

A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY
AND SIZE OF GRAVEL PRAGMENTS,
w69-08585

078

BURNASH, R. J. C.
AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM
RIVER PORECASTS ON THE NORTH COAST OF CALIFORNIA,
W69-08243

02A

BUSH, P. D.
DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, W69-08295 03A

BUTCHER, WILLIAM S. STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, $\rm W69-08546$

BUTCHER, W. S.

OPTIMUM OPERATIONS POR PLANNING OF A COMPLEX WATER RESOURCES SYSTEM,

W69-08540

OGA

BYBORDI, M.

THE VERTICAL HOVEMENT OF WATER IN STRATIFIED POROUS
HATERIAL 2. TRANSIENT STAGES OF DRAINAGE TO A WATER
TABLE,
M69-08203

02G

BYRD, D. WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY, $\mbox{W}69-08552$

CALVO, F. A.
A TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE ESPLUENT FOR IRRIGATION, W69-08623 05D

CAMPBELL, C. J.
A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES, w69-08469 07B

PRRPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID REGION, W69-08489 03B

WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, W69-08490

CAMPBELL, R. E. PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF NEW MEXICO, USG 18865.

CANNON, GLENN A.

OBSERVATIONS OF MOTION AT INTERMEDIATE AND LARGE SCALES IN A COASTAL PLAIN ESTUARY, W69-08598

CANTRELL, ROBERT P.
A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EPPLUENT FOR IRRIGATION, W59-08623

CAREY, ANDREW G., JR.
ZINC-65 IN ECHINODERMS AND SEDIMENTS IN THE MARINE
ENVIRONMENT OFF OREGON,

CARROLL, B. J.
BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS
IN THE ROSS BARNETT RESERVOIR,
W69-08563
05B

CARTER, LUTHER J.

WARM-WATER IRRIGATION AN ANSWER TO THERMAL POLLUTION, M69-08561 OSC

CASTLE, EMERY N.
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER, W69-08386 06B

- CAULFIELD, HENRY P., JR.

 NORTH AMERICAN WATER SUPPLY PROBLEMS AND THEIR SOLUTION, W69-08380

 OGB
- CAVADIAS, G. S.
 DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, w69-08242
- CECIL, LAWRENCE K.

 COMPLETE WATER REUSE,

 W69-08263

05D

- CHANG, M. T. WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, W69-08378 02D
- CHENEY, PHILIP B.
 A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, N69-08599

 05C
- CHERY, D. L., JR.

 THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESEARCH
 AND ITS CONSEQUENCES,
 W69-08233

 07A
- CLAY, H. E.
 TREATING WASTES IN A WATER-SHORT AREA,
 W69-08551 O5D
- COCHE, ANDRE G.
 PRODUCTION OF JUVENILE STRELHEAD TROUT IN A PRESHWATER IMPOUNDMENT,
 169-08517
 02H
- COLE, D. F.
 COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL
 MOISTURE IN WATER EPPICIENCY STUDIES,
 W69-08292
 02D
- COOK, DAVID O.

 CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SETTLING TUBE, W69-08583
- COOPER, JAMES B.
 GEOLOGY AND GROUNDWATER OCCURRENCE IN SOUTHEASTERN MCKINLEY
 COUNTY, NEW MEXICO,
 869-08287
 029
- CORBETT, E. S.
 SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN
 SOUTHERN CALIFORNIA,
 #69-08201

 02G
- COREY, J. C.
 TRACING GROUNDWATER WITH CHLOPIDE IONS AND TRITIUM THROUGH
 ACID KAOLINITIC SOIL,
 W69-08286 02P
- CROSS, FORD A.

 THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE
 BEHAVIOR OF FOUR BADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,
 M69-08522
- CYMIN, A.
 FEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING
 POLLUTION CONTROL PROGRAMS,
 #69-08555
 05G
- DAL CIN, RENZO

 'PEBBLE CLUSTERS' THEIR ORIGIN AND UTILIZATION IN THE STUDY OF PALAECCURRENTS,
 969-08608

 02J
- DARNELL, REZNEAT M.
 DETERMINATION OF PEEDING CHRONOLOGY IN FISHES,
 W69-08514 05C *
- DAVENPORT, DAVID C.
 ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, W69-08210 02D
- DAVIDSON, E. S. WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., 02P
- DAVIDSOH, K. D.
 AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE,
 W69-08449
 0.2C
- DAVID, L.
 GLACIAL AND PLUVIO-GLACIAL PORNATIONS OF THE LYON REGION
 (PRENCH),
 W69-08627
 02C
- DAVIES, I. CHEMICAL CHANGES IN COOLING WATER TOWERS, W69-08402 058
- DAVISON, ROBERT C.
 EIPERINENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-NATER FISHES,
 W69-08516
- DAVIS, E. A.
 INPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL
 OF CHAPARRAL,
 169-08483
 03B

- EFFECT OF A WATERSHED TREATHENT WITH PICLORAM ON WATER OUALITY, M69-084,84
- DAVIS, J. A.
 SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITANS AND S
 NATANS,
 #69-08524
 05C
- DAVIS, WILLIAM S.

 CONDITIONS FOR COEXISTENCE OF AQUATIC COMMUNITIES WITH THE PXPANDING NUCLEAR POWER INDUSTRY, W69-08420 05C
- DAY III, C. E.
 SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM FLUITANS AND S
 NATAMS,
 969-08578 05C
- DE COURSEY, DONN G.

 APPLICATIONS OF COMPUTER TECHNOLOGY TO HYDROLOGIC MODEL BUILDING,

 W69-08237

 07C
- DE VEGA, V. ROMAN
 THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE
 ANCHOVY (ANCHOA LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD
 HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA
 FLABELLUM LAMOUROUX),
 W69-08525
 05C
- DEAN, JOHN MARK
 METABOLISM OF ZINC-65 IN EUPHAUSIIDS,
 W69-08276 05C
- DEAN, JOHN M.

 THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE
 BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD,
 W69-08522
 05C
- DECKER, WAYNE L.
 POTENTIAL EVAPOTRANSPIRATION IN HUMID AND ARID CLIMATES, W69-08310 02D
- DINGMAN, S. L.
 THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS, R69-08422 05C
- DOBERNZ, A. K.
 COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL
 MOISTURE IN WATER EFFICIENCY STUDIES,
 W69-08292
 02D
- DONGUY, J. R.

 DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND MONBOVIA (PRENCH), W69-08255
- DOSS, BASIL D.

 EPPECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOLSEASON FORAGE SPECIES,

 169-08425

 021
 - SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION PROM WARM SEASON PERENNIAL FORAGE SPECIES, U69-08426
- DOSS, B. D.
 EFFECTS OF SOIL MOISTURE REGIME ON YIELD AND
 EVAPOTRANSPIRATION FROM COOL-SEASON PERENNIAL FORAGE
 SPECIES,
 W69-08427
 - EVAPOTRANSPIRATION BY IRRIGATED CORN, W69-08428 02D
- EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, w69-08429
- EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON, W69-08430 02D
- MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION AND NET RADIATION, W69-08431
- HOISTURE USE BY PORAGE SPECIES AS RELATED TO PAN EVAPORATION AND NET RADIATION, 469-08432
- EFFECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON HOISTURE USE AND YIELD OF CORN, W69-08434
- DOUDOROFF, PETER
 EXPERIMENTS ON THE DISSOLVED OXIGEN BEQUIREMENTS OF COLD-WATER PISHES, W69-08516
- DRACUP, JOHN A. OPTIMAL IDENTIFICATION OF LUMPED WATERSHED MODELS, $\mathbf{w}_{6}\mathbf{9}\mathbf{-0}\mathbf{8}\mathbf{570}$
- DRAKE, R. L.
 SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE PLOW
 PROBLEM,
 469-08575
 02F

DRUMMOND, WAYHON
BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,
M69-08565
05C

DUCKLER, A. E.

MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION,
W69-08549

03A

DUFFY, P. D.

RAINPALL AND STREAMPLOW FROM SMALL TRRE-COVERED AND PERNCOVERED AND BURNED WATERSHEDS IN HAWAII,

#69-08510

02G

DUKE, T.

INFLIFICE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF 2N-65 BY AN EXPERIMENTAL COMMUNITY, W69-08267

DUNFORD, E. G.
FORESTS -- USERS OF WATER,
W69-08512 03B

DUNLOP, STUART G. SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS, #69-0.0622

DUTTWELLER, D. W.

THE RESPONSE OF WATPR TEMPERATURES TO METEOROLOGICAL
CONDITIONS,
W69-08417

01a

ERERHARDT, W. A.
BIOLOGICAL OXIDATION BATES IN MINE ACID WATER REGIMPS, W69-08379 05G

FDINGER, JOHN E.

THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS,

W69-08405
05C

EDINGER, J. E.
ANALYZING STEAM POWER PLANT DISCHARGES,
W69-08411 058

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS, W69-08417 01A

EL GAMASSY, A. M.
WATER ROONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS,
W69-08303 03F

PRODS, G.
SOME PROBLEMS OF STREAMFLOW PORECASTS BASED ON INFORMATION THEORY, M69-08241 02P

ESOGBUE, A. M.

OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES
SYSTEM,
469-09500

PAN, LOH NIEN
TURBULENT BOUYANT JETS INTO STRATIFIED OR PLOWING AMBIENT
FLUIDS,
W69-08423

PAN, LOH-NIEN
NUMERICAL SOLUTIONS OF TURBULENT BOUYANT JET PROBLEMS,
W59-08424

PELIX, DAVID W.
AN IMEXPENSIVE RECORDING SETTLING THRE FOR ANALYSIS OF SANDS, 'W69-08582 07B

PENIMORE, J. W.
TRACING GROUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH
ACID KAOLINITIC SOIL,
W69-08286 02F

PERRAL, R. L.
AN OPPRATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM RIVER PORECASTS ON THE NORTH COAST OF CALIFORNIA, * 024

FFOLLIOTT, PETER P.
OBSERVATIONS OF SNOWPACK ACCUMULATION, NELT, AND RUNOPF ON A SMALL ARIZONA WATERSHED, W69-08493 03B

OBSERVATIONS OF SNOW ACCUMULATION AND HELT IN DEMONSTRATION CUTTINGS OF PONDEROSA PINE IN CENTRAL ARIZONA, 039.

PIERING, MYRON B.
PORECASTS WITH VARYING RELIABILITY,
W69-08545 02

PINDLAY, B. F.

PRECIPITATION IN MORTHERN QUEBEC AND LABRADOR AN
EVALUATION OF MEASUREMENT TECHNIQUES,
469-08587

028

FINER, J.
DESALINATION-POWER PLANT PROVES ECONOMICALLY FEASIBLE, W69-08295 03A

PISCHLER, K.

INFLUENCE OF ENVIRONMENTAL PACTORS ON THE CONCENTRATIONS OF ZN-65 BY AN EXPERIMENTAL COMMUNITY, w69-08267 05C

POEHRENBACH, J. EUTROPHICATION, W69-08518

050

FOLSOM, T. R.
AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM, M69-08271 05B

FORD, DAVIS
REUSE CAN BE CHEAPER THAN DISPOSAL,
W69-08260 05D

FOSTER, HERBERT B., JR.
RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER,
W69-08215 05D

FOWLER, MELVIN L.
A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO, M69-08396
07B

FOWLER, SCOTT W.
METABOLISM OF ZINC-65 IN EUPHAUSIDS,
W69-08276 05C

FRANKEL, MICHAEL L.
CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES, w69-08235
04B

PRAZIER, H. M.
COMPUTATIONAL ANALYSES OF MOISTURE PLUX OVER NORTH AMERICA,
469-08744 028

FREETH, S. J.

A RAPID HETHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY
AND SIZE OF GRAVEL FRAGMENTS,
W69-08585

07B

PROST, TERRENCE P.
PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER
SUPPLIES,
M69-08282
05c

PRUTIGER, HANS
SNOW AVALANCHES ALONG COLORADO HOUNTAIN HIGHWAYS, W69-08445 02C

A MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES, W69-08447 02C

FUNGAROLI, A. A.
SIMILARITY APPROXIMATION POR THE BADIAL SUBSURPACE FLOW
PROBLEM,
M69-08575
02F

GALLE, O. K.
PE, NN, NI, CO, SR, LI, ZN, AND SILICA IN STREAMS OF THE
LOWER KANSAS RIVER BASIN,
W69-08204
05A

GANNON, J. J. PORECASTING HEAT LOSS IN PONDS AND STREAMS, w69-08415 05B

GARCIA, GEORGE
SUMMER DEFERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT
RANGES,
W69-08462
04A

GARCIA, R. M.
MOISTURE-PETENTION CAPACITY OF LITTER UNDER TWO ARIZONA
CHAPARBAL COMMUNITIES,
W69-08488
02G

GARTHE, EDMUND C.
WASTEWATER REUSE AT THE GRAND CANYON,
W69-08290 05D

GARY, HOWARD L. WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, #69-08490 03B

GELPI, E.
OLEFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,
M69-08284
05A

GERKING, SHELBY D.

INPLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN METABOLISM OF BLUEGILL SUNFISH, W69-08520

05c

GERSHANOVICH, D. E.
NEW DATA ON GEOHORPHOLOGY AND RECENT SEDIMENTS OF THE BERING
SEA AND THE GULF OF ALASKA,
M69-08249
02J

GEYER, J. C.
ANALYZING STEAM POWER PLANT DISCHARGES,
W69-08411 05B

THE RESPONSE OF WATER TEMPERATURES TO METEOROLOGICAL CONDITIONS,

42

M69-08817

GIDDINGS, MARVIN
EFFECTS OF HURRICANE STORMS ON AGRICULTURE,
M69-08568 02B

GILBERT, WILFRED C.
WASTEWATER REUSE AT THE GRAND CANYON,
W69-08290
05D

GISCHLER, C. E.
A HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN,
W69-08304 07A

GLENDENING, GEORGE E.

REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING
OF OAK-MOUNTAINMAHOGANY CHAPARRAL,
021

GOLDIN, ABRAHAM S. ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS, W69-08212 056

GOMEZ, HECTOR J.
WATER REUSE IN MONTERREY, MEXICO,
W69-08289 05D

GOODELL, B. C.
STRRAMPLOW VOLUMES AND HYDROGRAPHS BY FLUORESCENT DYES, W69-08480 07B

WATERSHED TREATMENT EFFECTS ON EVAPOTRANSPIRATION, W69-08481

GOTTFRIED, G. J.
A SHIFLDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SNOWPACK TEMPERATURES, W69-08469 07B

GRAVES, WILLARD L.
THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC
COOLING OPERATIONS,
M69-08405
05C

GRAY, PRANK J.
PRACTICAL IRRIGATION WITH SEWAGE EFFLUENT,
W69-08619
05D

GRAY, MACK H., III.
UNSTRADY FLOW IN A RESERVOIR-CONDUIT SYSTEM,
W69-08202 08B

GREEN, WIN
PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A
SEMIARID REGION,
W69-08489
03B

GROSS, AVRUM M.
THE MARITIME BOUNDARIES OF THE STATES,
W69-08329
06E

HAGAN, ROBERT M.
ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, 169-08210 02D

HAILS, JOHN R.

THE SIGNIPICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND MODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN, U69-08578 02L

HAIMES, Y. Y.

INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, 02F

HALL, W.

BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR,
W69-08403
08B

HALL, W. A.
OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES
SYSTEM,
W69-08540
06A

HAMER, E. A. G.
REVERSE OSHOSIS MEMBRANE REGEMERATION,
W69-08395

HANSEN, EDHARD A.
OBSERVATIONS OF SHOWPACK ACCUMULATION, HELT, AND RUMOFF ON A
SHALL ARIZONA WATERSHED,
W69-08493
03B

OBSERVATIONS OF SNOW ACCUMULATION AND MELT IN DEHONSTRATION CUTTINGS OF PONDEROSA PINE IN CENTRAL ARIZONA, W69-08494 03B

HARBECK, G. EARL, JR.
THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, M69-08406

ESTIMATING FORCED EVAPORATION FROM COOLING PONDS, W69-08414

A PRACTICAL FIELD TECHNIQUE FOR MEASURING RESERVOIR EVAPORATION UTILIZING MASS - TRANSPER THEORY, W69-08418

HARPER, CAROL L. NITROGEN FIXATION IN SOME ANOXIC LACUSTRINE ENVIRONMENTS, W69-08280 02H

HARTMAN, L. M.
EFFECTS OF HURRICANE STORMS ON AGRICULTURE,
#69-08568 028

HASS, JEROME E.
OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, W69-08547 05F

HAUPT, HAROLD F.
A SIMPLE SNOWMELT LYSIMETER,
W69-08206

020

THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM METEOROLOGICAL EVENTS, W69-08435 02C

SHOW CATCH BY CONIFER CROWNS, W69-08436 02C

HAYASHI, T.
DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE, W69-08412 08B

HAZEN, RICHARD FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT NO 1, REQUIREMENTS AND SOURCES, W69-08257

HEANEY, JAMES P.
MATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-BESOURCE SYSTEMS, W69-08541

HENDRICKS, E. L.
HYDROLOGIC DATA SYSTEMS--DEVELOPING CONCEPTS,
W69-08606 07A

HERMAN, THEODORE

A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN WATER RESOURCES ENGINEERING,
W69-08251

06a

HIBBERT, A. R.
WATER YIELD CHANGES AFTER CONVERTING A FORESTED CATCHMENT TO GRASS,
M69-08200 03B

HILER, EDWARD A.

EFFECT OF SEDIMENT CONCENTRATION ON WELL RECHARGE IN A FINE SAND AQUIFER,
W69-08574 02F

HILL, B. V. WHAT THE HILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 05D

HOLLAND, DAVID

REPECTS OF HURRICANE STORMS ON AGRICULTURE, #69-08568

028

HOLM-HANSEN, OSKUND ALGAE AMOUNTS OF DWA AND ORGANIC CARBON IN SINGLE CELLS, #69-08278 02K

HOLH, PAUL L.

DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES, W69-08389

HORTON, J. S.
GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION,
169-08491
03B

HOWARD, E. D.
PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION,
W69-08216

HOYT, JOHN H.
THE SIGNIFICANCE AND LIMITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND HODERN SEDIMENTARY ENVIRONMENTS OF THE LOWER GEORGIA COASTAL PLAIN, W69-08578

02L

HUANG, C. J.

HATHEHATICAL HODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION,

M69-08549

03A

HUFSCHHIDT, MAYHARD M.
RESPARCH ON COMPREHENSIVE PLANNING OF WATER-RESOURCE SYSTEMS, 469-08362 068

HUMPHRYS, C. R.

LAKE TERRINOLOGY WATER BLOOM,

W69-08279 05C

HUNG-SHUEM, SHAO
PALEOLIMBETIC SALINITY OF DZUMGAR AND ORDOS BASINS,
#69-08594
02H

HUTCHINSON, G. E.
STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL
ANALYSES OF A CORE PROM LINSLEY POND, MOSTH BRANFORD,
W69-08521
02H

AUTHOR INDEX

ING-KRU

INGEBO, PAUL A.

FFFECT OF HEAVY LATE-FALL PRECIPITATION ON BUNOFF FROM A
CHAPARRAL WATERSHED,

150,0225

INGERO, P. A.
IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL
OF CHAPARRAL,
050-0602

EPPECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER OUALITY,

BURNED CHAPARRAL TO GRASS EARLY EFFECTS ON WATER AND SEDIMENT YIELDS FROM TWO GRANITIC SOIL WATERSHEDS IN ARIZONA,

IONESCU, F.
SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR PLOOD ROUTING AND PLOOD FORECASTING PROBLEMS, W69-08232

IRIZARRY, N.
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC FOPULATIONS, #69-08528

05c

JARRETT, ROBERT E.
CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN
THE NEUTRALIZATION OF ACID STREAMS,
69-08376 5G

JASKE, R. T.

THERMAL DISCHARGES REQUIRE ADVANCE PLANNING, M69-0856M 05C

JENKINS, DAVID
ODOFOUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2METHYLBORNANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL
ACTINOMYCETES,
W69-08219
05a

JEN, YUAN SURPACE DISCHARGE OF HORIZONTAL WARM-WATER JET, W69-08421 05B

JINDRICH, VLADIMIR
RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE
LOWER FLORIDA KEYS,
W69-08577
02L

JOHANNES, R. F. THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, M69-08274 05C

JOHNSON, ALBERT E.
AN INVESTIGATION INTO THE EPPECTS OF WARMED WATER PROMMARCHWOOD POWER STATION INTO SOUTHAMPTON WATER,
WAS-BRAND OSC

JOHNSON, P. L. MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN ALASKA, w69-08272 05C

JOHN, EDWARD C.

GEOLOGY AND GROUNDWATER OCCURRENCE IN SOUTHEASTERN MCKINLEY
COUNTY, NEW MEXICO,
WG9-08287

JONES, GARY C.

W69-08392 068

JOPLING, WILLIAM P.
RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER, M69-08215 05D

JOY, R. J.
COMPARISON OF MATERIALS FOR REDUCING EVAPORATION OF SOIL
MOISTURE IN WATER EPPICIENCY STUDIES,
W69-08292 02D

JUDSON, ARTHUR
SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN
UNITED STATES,
#69-08446 02C

THE WEATHER AND CLIMATE OF A BIGH: HOUNTAIN PASS IN THE COLORADO ROCKIES, W69-08448 02C

KAJOSAARI, EERO DROUGHTS IN PINNISH WATERCOURSES WITH REFERENCE TO WATER SUPPLY AND POLLUTION CONTROL (PINNISH), w69-08254 -028

KALISH, R. L.
REVERSE OSMOSIS MEMBRANE REGENERATION,
W69-08395 03A

KANGOS, JAMES D.
A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, W69-08599 05C

KARDOS, LOUIS T.

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 05D

CROP RESPONSE TO SEWAGE EFFLUENT, W69-08617

KARTVELISHVILI, N. A. THEORY OF STOCHASTIC PROCESSES IN HYDROLOGY AND RIVER RUNOPF REGULATION,

02E

KERCH, C. P.
WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968, M69-08588 02P

KEELER, C. M.
SNOW ACCUMULATION ON MOUNT LOGAN, YUKON TERRITORY, CANADA. 249-08207 02C

KILMER, VICTOR J.

YIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN
AT FOUR LEVELS OF SOIL MOISTURE,

KILMER, V. J. EPPECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-08429 02D

KIRKHAM, DON
TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH
DRAINS,
#69-08576

KLAWITTER, RALPH A. FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN, W69-08437 044

DRAINAGE, W69-08438 04A

HYDROLOGY OF WETLAND POREST WATERSHEDS, W69-08440 04A

SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, W69-08441 04A

WIND DAMAGES IMPROPERLY PLANTED SLASH PINE, W69-08442

KLEINECKE, DAVID
PREPARATION, VERIFICATION AND USE OF A DIGITAL GROUNDWATER
SIMULATION PROGRAM,
469-06216

KNEESE, ALLEN V.
ECONOMIC AND RELATED PROBLEMS IN CONTEMPORARY WATER
RESOURCES MANAGEMENT,
W69-08384
06B

KNIPE, O. D.
INFLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE GRASSES, M69-08467

KOENIG, LOUIS
REUSE CAN BE CHEAPER THAN DISPOSAL,
W69-08260 05D

KOH, ROBERT C. Y.
SELECTIVE WITHDRAWAL FROM DENSITY - STRATIFIED RESERVOIRS, W69-08419
05C

KOLLAR, K. L.
BETTER MANAGEMENT OF WATER RESOURCES IS A MUST IF FUTURE NEEDS ARE TO BE MET,
W69-08557
05G

KOUNTZ, R. RUPERT
CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN
THE NEUTRALIZATION OF ACID STREAMS,
M69-08376 5G

BIOLOGICAL OXIDATION RATES IN MINE ACID WATER REGIMES, W69-08379

KRALOVIC, RAYHOND C.
SURVIVAL AND ACTIVITY OF SEWAGE MICHOORGANISMS IN ACID HINE WATER,
W69-08400
05D

KRAUS, RUDY
POOD HABITS OF THE YELLOW BASS, ROCCUS MISSISSIPPIENSIS,
CLEAR LAKE, IOWA, SUMMER 1962,
M69-08515
05C

KRITSKIY, S. N.
SORE STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC
SERIES,
W69-08614 07C

KRONE, R. B.
THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS, W69-08621
05D

RRULC, ZVONIMIR
THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,
W69-08297

KUEHL, DONALD W.

OPERATIONAL STREAMFLOW FORECASTING WITH THE SSARR MODEL, W69-08245

028

KUENZLER, EDWARD J.

ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE
ZOOPLANKTON,

ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON, W69-08529

KUENZLER, E. J.
PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS,
W69-08526 05C

KUJALA, NORMAN F. RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, W69-08530 05C

KU, TEH-LUNG
PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN
THE RED SEA,
M69-08581
02J

KWAN, JOHN Y.

A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION, #69-08238

LABADIE, JOHN W. OPTIMAL IDENTIFICATION OF LUMPED WATERSHED MODELS, W69-08570 . 02a

LABERGE, RONALD H.
THERMAL DISCHARGES,
W69-08413

05C

LACT, W. J.

PEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING POLLUTION CONTROL PROGRAMS, 05G

LAMEY, R. L.
INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID
BASIM ARIZONA, U.S.A.,
M69-08300 02F

LAME, RUSSELL W. WATER USE AND RELATED COSTS WITH COOLING TOWERS, #69-08407

LANG, L. W.
GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI
AND LOUISIANA,
B69-08264
02P

LARDIERI, N. J.
THE ECONOMICS OF CLEAN WATER,
W69-08548

051

LARSEN, I. LAUREN

BADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON,

W69-08530

05C

LARSON, THURSTON E.
WATER USE AND RELATED COSTS WITH COOLING TOWERS,
W69-08407 05G

LAW, JAMES P., JR.
SOIL RESPONSE TO SEWAGE EFFLUENT IRRIGATION,
W69-08616 05D

LE GOFF, R.

LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS
ON MARKINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL,
W69-08611
05C

LEAF, CHARLES F.

AREAL EXTENT OF SHOW COVER IN RELATION TO STREAMPLOW IN CENTRAL COLORADO, 02C

LEET, WILLIAM L.
THE CONCENTRATION OF ZN-65 BY OYSTEBS MAINTAINED IN THE
DISCHARGE CANAL OF A NUCLEAR POWER PLANT,
W69-08268
05C

LEE, H. H. H. HATHEMATICAL HODEL AND COMPUTER PROGRAM FOR SIMULATION AND OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR SALINE WATER CONVERSION, W69-08549

LEE, R. WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, $$\rm W69-08378$

LEVY, H. A.
OBSERVED DIFFRACTION PATTERN AND PROPOSED HODELS OF LIQUID WATER,
469-08560
01A

LEWIS, CURTIS 4. TRANSPER OF ZW-65 AND CR-51 THROUGH AW ESTUARINE FOOD CHAIN, $869\!-\!08273$

LIAO, K. R. THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON METS OF VARIOUS ORDERS,

W69-08211

LIKENS, G. E.
MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN
ALASKA,
M69-08272
05C

078

LONG, I. F.
SURFACE RESISTANCE OF CROP CANOPIES,
W69-08573 02D

LOUCKS, RONALD H.
MATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND
CHLORINE IN THE GREAT LAKES,
M69-08562
05A

LOURENCE, F. J.
COMPARISON BETWEEN RAIN GAGE AND LYSIMETER MEASUREMENTS.
169-08208
028

LOYELL, HAROLD L.
AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, W69-08466

LUCIANO, D.
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC
POPULATIONS,
#CG-06528 05C

LULL, HOWARD W.

INPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD,
FLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA
NEEDED FOR PRODUCTION,
W69-08508

04D

LUNCEFORD, WILLIAM
AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA
RIVER,
469-08399
066

MACHATSCHEK, FRITZ GEOMORPHOLOGY, W69-08226

02B

MAJOR, JACK POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN WESTERN STATES WITH EMPHASIS ON CALIFORNIA, W69-08308

MAKI, WILBUR R.
REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-08387 06B

MANDOUR, M. S. WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS, W69-08303 03F

MANNOS, MURRAY
AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN
OPERATION OF A SYSTEM OF DAMS,
W69-08536
04A

MARGOLIS, STANLEY V.
ELECTRON HICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL ABRASION FEATURES ON QUARTZ SAND GRAINS, 02J

MARIUS, JOHN B.
SOURCE AREAS OF STORM RUNOFF,
W69-08569 02

MARTINELLI, M., JR.
AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS
AND FUTURE PROSPECTS,
W69-08444

02C

A MANUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES, $\ensuremath{\text{W69-08447}}$

AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE, #69-08449 02C

INFLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SHOW FENCE ON SIZE AND LOCATION OF LEE DRIFT, 02C

MARTIN, PAUL E.
AUTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN HYDROLOGY, W69-08210

HASSEY, DEAS T. REGIONAL RESEARCH IN WATER IN THE MORTH CENTRAL REGION, W69-03391

OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES PROBLEMS, W69-08393

HATALAS, M. C. REVIEW OF SURFACE WATER SYSTEMS AWALYSIS, W69-08533

MAXHELL, C.
BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR, 08B

HCCARTY, PERRY L. TREATHENT OF HIGH MITRATE WATERS, MCC-PAE

W69-08228 05D

MCCULLOCH, C. Y.
IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL
OF CHAPARRAL,
W69-09483
03B

MCDONALD, R. R. GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, W69-08491 03B

HCNULTY, JAMES A.

DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC
TITRATION,
W69-08559
05a

MCWHORTER, J. C.
A NONDIMENSIONAL APPROACH TO THE PLOW OF WATER IN PLUMES AND CANALS,
U60-08308 088

MEDSKER, LLOYD L.

ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2METHYLBORNANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL
ACTINOMYCETES,
869-08219 158

MRIEROTTO, RICHARD R.

DETERMINATION OF FEEDING CHRONOLOGY IN FISHES, W69-08514 05C

MENKEL, M. F.
SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC
SERIES,
469-08614
07C

MICHELSEN, D. L.
RESEARCH ON TREATMENT OF DYE WASTES,
W69-08558 050

MIKULSKI, ZDISHAW
AN OUTLINE OF POLAND*S HYDROGRAPHY (POLISH),
w69-08253 02A

MILLER, W. FRANK
FOREST SITE AMELIORATION IN THE COASTAL PLATWOODS OF
MISSISSIPPI,
W69-08397
04a

MILLIMAN, JOHN D.
PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN
THE RED SEA,
W69-08581 02J

MINNEHAN, ROBERT P.
A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS, W69-08542 05D

MINSHALL, NEAL
PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN
WISCONSIN,
058

MLADENOVIC, MILOVAN
THE APPLICATION OF GEOELECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,
#69-08297

MOBAREK, ISMAIL SURFACE DISCHARGE OF HORIZONTAL WARM-WATER JET, W69-08421 05B |

MODARRESI, HASSAN G.
A COMPACT GAGE FOR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOOSE SAND PARTICIPS,
M69-08584

MOELLER, DADE W.
PNVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS, W69-08212 05G

MOLZ, F. J.
SIMILARITY APPROXIMATION FOR THE BADIAL SUBSURFACE PLOW PROBLEM, M69-08575

MOORE, ROBERT T.

DETERMINATION OF TOTAL HITROGEN IN WATER BY MICROCOULOMETRIC TITRATION,
W69-08559

05a

MORESHET, S.
STOMATAL INFILTRATION MEASUREMENTS AS AM INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTOM, W69-08293

MORGAN, D. L.
COMPARISON BETMEEN RAIN GAGE AND LYSINETER MEASUREMENTS.
W69-08208
02B

MORTON, B. R.
ON A MOMENTUM-MASS FLUX DIAGRAM FOR TURBULENT JETS, PLUMES AND WAKES,
W69-08410
08B

HOTTS, WARD S.

THE COMPROL OF GROUNDWATER OCCURRENCE BY LITHOFACIES IN THE GUADALUPIAN REEF COMPLEX WEAR CARLSBAD, NEW MEXICO, W69-08294

048

MOZYENY, BAHRAM PROPAGATION OF PLOOD WAVES IN OPEN CHANNELS, W69-08590 02E

MUIR, T. C. SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS, w69-08223

MURDOCH, MARIANNE B.
THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIFLORA IN
CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD
CHAINS,
169-08277
05C

MYERS, EARL A.

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, W69-08377 05D

NAGAI, S. GROUND WATER RESOURCES IN THE KOCHI PLAIM, SOUTHWEST JAPAN (JAPANESE), 69-08248

NARTEN, A. H.
OBSERVED DIFFRACTION PATTERN AND PROPOSED MODELS OF LIQUID WATER,

NICHOLS, M. STARR
PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN
WISCONSIN,
W69-08205
05B

NILES, THOMAS M.
FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION.
REPORT NO 1, REQUIREMENTS AND SOURCES,
W69-08257
06D

NORDIH, CARL F.
SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY
RAINFALL AND RUNOPP,
W69-04572 02A

ODUM, R. P.
THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, W69-08274
05C

OERTLI, J. J.

EPPECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS
IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC
WATER POTENTIAL DIPPERENCES BETWEEN ROOT IYLEN AND EXTERNAL
MEDIUM,
M69-08291

021

OFIR, M.
STONATAL INFILTRATION MEASUREMENTS AS AN INDICATOR OF THE
WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON,
W69-08293
03F

ORCUTT, RICHARD G.
AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING
AQUIPER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES
ATTH RECLAIMED WASTEWATER,
W69-08625
05D

ORLOB, GERALD T.

RETURNIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY
CONSIDERATIONS,
W69-08537
02L

ORO, J.
OLEPINS OF HIGH HOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE, W69-08284 05A

OSBORN, HERBERT B. VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE SOUTHWEST, \$W69-08309\$

OSTERBERG, CHARLES
RADIOZINC DECLINE IN STARRY PLOUNDERS AFTER TEMPORARY
SHUTDOWN OF HANFORD REACTORS,
W69-08270
05C

OSTERBERG, CHARLES L.

THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE
BEHAVIOR OF FOUR RADIONUCLIDES IN A HARINE BENTHIC AMPHIPOD,
W69-08522

OSC

RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON, $\ensuremath{\text{W6\,9-085\,30}}$

OSTREM, G.
GLACIER MASS-BALANCE MEASUBEMENTS--A MANUAL FOR FIELD AND OFFICE WORK, W69-08227 02C

OTKUN, GALIP GROUNDWATER POTENTIAL OF KARST AQUIPERS IN SAUDI ARABIA, #69-08296 02F

O'MEILL, IAN C.
SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS,
W69-08591 02E

PAESSLER, A. H.
WATER QUALITY MANAGEMENT IN VIRGINIA,
W69-08554 05G

46

PANGLE, J. C., JR.
WHAT TRE BILLS ARE DOING TO CONTROL WATER POLLUTION,
W69-08556 05D

PANNELL, JOHN P. H.
AN INVESTIGATION INTO THE EFFECTS OF WARMED WATER FROM MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER, W69-08408 05C

PARIKH, S. C.

OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES
SYSTEM,
102-0-05500
06A

PARKER, FRANK L. STATUS OF RADIOACTIVE WASTE DISPOSAL IN U.S.A., W69-08214

PASE, CHARLES P.
REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING
OF OAK-HOUNTAINMAHOGANY CHAPARRAL,
169-08470 021

SHRUB SEEDLING REGENERATION AFTER CONTROLLED BURNING AND HERBICIDAL TREATMENT OF DENSE PRINGLE MANDANITA CHAPARRAL, w69-08071 021

BURNED CHAPARRAL TO GRASS EARLY EFFECTS ON WATER AND SEDIMENT TIELDS FROM TWO GRAWITIC SOIL WATERSHEDS IN ARIZONA, #69-08885

PASE, C. P.
IMPROVING WATER YIELD AND GAME HABITAT BY CHEMICAL CONTROL
OF CHAPARRAL,
MKG-DARGA 03B

EFFECT OF A WATERSHED TREATMENT WITH PICLORAM ON WATER QUALITY, W69-08484

HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND BIRCHLEAP MOUNTAINMAHOGANY, 03B

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES, W69-08488 02G

PARMASH, H.
BASIC STUDY OF JET FLOW PATTERNS RELATED TO STBEAM AND
BESERVOIR BEHAVIOR,
W69-08403
08B

PEARCE, J. B.

LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS
ON MARRINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL,
W69-08611
05C

PELTON, DOUGLAS J.
A SYSTEMS ANALYSIS OF AQUATIC THERNAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, MS9-DAS99 05C

PENTLAND, R. L. DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, W69-08242 07C

PERRINE, R. L.
INDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION, W69-08550 02F

PETERSON, H. B.
SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION,
W69-08618

PETERS, HELEN J.

CALIPORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN MANAGEMENT STUDIES,

W69-08235

04B

PHELPS, D. K.
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS, M69-08528 05C

PHILLIPS, K. W. WATER RESOURCES AND DEVELOPMENT WATER RESOURCES, $\mathbf{w}_{6} + \mathbf{0} + \mathbf{0}$

PICA, M.
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE,
M69-08258 02J

PIETRARU, VITALIE
ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID
OF ELECTRONIC COMPUTERS (PRENCH),
W69-08231
02G

POMEROY, L. R. THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, $$69\!-\!08274$$

PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS, 969-08526 05C

PORGES, RALPH

BEGIONAL WATER QUALITY STANDARDS,

W69-08213

PRICE, RAYMOND
POSSIBILITIES OF INCREASING STREAMFLOW FROM FOREST AND RANGE
WATERSHEDS BY MANIPULATING THE VEGETATIVE COVER-THE BEAVER
CREEK PILOT WATERSHED EVALUATION STUDY,
U49-08495

PRICE, T.
INFLUENCE OF ENVIRONMENTAL PACTORS ON THE CONCENTRATIONS OF ZN-65 BY AN EXPERIMENTAL COMMUNITY, W69-08267

05c

PRIVE, M.

DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND MONROVIA (PRENCH), W69-08255

RAGOTZKIE, ROBERT A.
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W69-08404 02H

RAHMAN, MD. ATAUR
EPFECT OF SEDIMENT CONCENTRATION ON WELL RECHARGE IN A PINE
SAND AQUIPER,
450-0574
02P

RATKOVICH, D. YA.

PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTATIONS OF STREAMFLOW REGULATION, W69-08613

RAWSON, D. S.
MORPHOMETRY AS A DOMINANT FACTOR IN THE PRODUCTIVITY OF LARGE LAKES,
W69-08519
02H

RAYMONT, JOHN E. G. AN INVESTIGATION INTO THE EFFECTS OF WARNED WATER FROM MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER, w69-08408 05C

REMSON, IRWIN
SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE PLOW
PROBLEM,
W69-08575
02P

RENPRO, WILLIAM C.
RADIOZINC DECLINE IN STARRY FLOUNDERS AFTER TEMPORARY
SHUTDOWN OF HANFORD REACTORS,
W69-08270
05C

REYNOLDS, HUDSON G.
GAZING IN RELATION TO BUNOFF AND EROSION ON SOME CHAPABEAL WATERSHEDS OF CENTRAL ARIZONA,

REYNOLDS, H. G.
THE WORKMAN CREEK EXPERIMENTAL WATERSHED,
W69-08473
03B

REYNOLDS, JOHN E.

W69-08392 068

RICE, R. N. SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN SOUTHERN CALIFORNIA, W69-08201 02G

RICHARDSON, E. C.
EFFECTS OF SOIL MOISTURE REGIME ON TIELD, NUTRIENT CONTENT,
AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES,
W69-08429
02D

RICHARDSON, W. F.

EPPECTS OF EXTRINAL SALT CONCENTRATIONS ON WATER RELATIONS
IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC
WATER POTENTIAL DIFFERENCES BETWEEN ROOT XYLEM AND EXTERNAL
MEDIUM,
W59-08291

021

RICHARDS, R. T. ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN, W69-08409 05C

RICHARDS, STERLING J.
WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY PLANTS,
W69-08302

RICH, LOWELL R.
PRELIMINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE CREEK, ARIZONA WATERSHEDS,
169-08472 03B

THE WORKMAN CREEK EXPERIMENTAL WATERSHED, 03B

SURPACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, ARIZONA, W69-08474

GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL NATERSHEDS OF CENTRAL ARIZONA,

WATER TIELDS RESULTING FROM TREATHENTS APPLIED TO MINED COMIFER WATERSHED, 03B

RICH, L. R.

EROSION AND SEDIMENT MOVPMENT FOLLOWING A WILDFIRE IN A PONDEROSA PINE FOREST OF CENTRAL ARIZONA,

PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION, W69-08478 038

RILEY, J. PAUL
A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND
CALCULATE VOLUMES OF PRECIPITATION,
W69-08238
07C

RISCH, GART S.

APPLICATION OF COMPUTERIZED OPERATIONS RESEARCH TECHNIQUE FOR OPTIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER PROJECT, W69-08240

TTER, ROY H.
PUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON BEGION.
REPORT NO 1, REQUIREMENTS AND SOURCES,
06D

ROBINSON, T. W.
GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, W69-08491 03B

OCKWOOD, DAVID M.
APPLICATION OF STREAMPLOW SYNTHESIS AND RESERVOIR REGULATION
-'SSARY--PROGRAM TO THE LOWER MEKONG RIVER,
022

RODRIGUEZ-ITURBE, IGNACIO
SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY
BAINFALL AND RUNOFF, W69-08572

ROPPMAN, B.
THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT MARSH, W69-08274 05C

ROSENBERGER, LEE
BIOLOGICAL OXIDATION RATES IN MINE ACID WATER REGIMES,
M69-08379
05G
05G

ROSENBERG, A. B.
DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, w69-08242 07C

ROSE, GORDON D.
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION, W69-08391

OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES PROBLEMS, W69-08393 06B

ROSS, DAVID A.
PRECIPITATION AND LITHIFICATION OF DEEP-SEA CARBONATES IN
THE RED SEA,
869-08581 02J

RUDEK, FRED P. WATER REUSE IN SPACE,

RUSSELL, CLIFFORD S.
AN APPLICATION OF NON-LINEAR PROGRAMMING TO THE PLANNING OF MUNICIPAL WATER SUPPLY SYSTEMS SOME RESULTS,
06A

RUST, BRIAN R.
THE SEDIMENTOLOGY OF A BRAIDED RIVER,
02J

SALO, ERNEST O.

THE CONCENTRATION OF ZN-65 BY OYSTERS HAINTAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT,

05C

SANTIAGO, R. J.
TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC POPULATIONS,

SARMANOV, O. V.
GAMMA COBRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM STREAMPLOW REGULATION,

SATTERLUND, DONALD R. SNOW CATCH BY CONIFER CROWNS,

SAYRE, WILLIAM W.
DISPERSION OF SILT PARTICLES IN OPEN CHANNEL PLOW. ¥69-08592

SCHEIDEGER, A. P.
THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON NETS
OF VARIOUS ORDERS,

SCHELSKE, CLAIRE L.

ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE HOLLUSCS FROM THE LOWER TRENT AWD NEUSE RIVERS, 05C

SCHERNERHORN, VALI P.

W69-08436

OPERATIONAL STREAMFLOW FORECASTING WITH THE SSARR MODEL,

SCHLANGER, M. DISTRIBUTED PARAMETER MODEL OF THERMAL EFFECTS IN RIVERS,

SCHMID, ALLAN A.
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT, W69-08388

SCHNEIDER, H. J.
OLEPINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE,
M69-08284
05A

SCOTT, JON T.
HEAT BUDGET OF AN ICE COVERED INLAND LAKE, W69-08404

SEGINER, IDO
NET LOSSES IN SPRINKLER IRRIGATION, W69-08305 03F

RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE 02E W69-08571

SHEPARD, R. W. OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES W69-08540 06 A

SHMUELI. MUELI, E. STOMATAL INPILTRATION MEASUREMENTS AS AN INDICATOR OF THE WATER REQUIREMENT AND TIMING OF IRRIGATION FOR COTTON,

SHUTO, N.
DIPPUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE 08B

SILVERMAN, M.

LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL, 469-08611

05C

MEK, JOHN E.
SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM PLUITARS AND S NATANS, W69-08524

SLOUGHFY, JAMES L.
AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MIME DRAINAGE WATERS, W69-08466 05D

SMALL, LAWRENCE F.
METABOLISM OF ZINC-65 IN EUPHAUSIIDS,
05C

SMERDON, ERNEST T.

EFFECT OF SEDIMENT CONCENTRATION ON WELL BECHARGE IN A FINE SAND AQUIFER,
469-08574

02F

SMITH, A. L. WHAT THE MILLS ARE DOING TO CONTROL WATER POLLUTION, W69-08556 05D

FRANK A. A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT, #69-08599 05C

IITH, JAMES L.
USE OF NUCLEAR TECHNIQUES IN SMOW AND RELATED WATERSHED
HANAGERENT, W69-08496

SMITH, J. M. PUBLIC HEALTH PACTORS IN REACTOR SITE SELECTION, W69-08216

SMITH, ROBERT OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORATORY, W69-08534 050

SONG, CHARLES S. PROPAGATION OF PLOOD WAVES IN OPEN CHANNELS, W69-08590

SUGGESTIONS ON COMPILATION OF SMALL SCALE HYDROGEOLOGICAL MAPS,

#69-08595

O7C

SREEKUHARAW, C.
AN ESTINATE OF THE RESPONSE BATE OF ALBACORE TO CESIUM, M69-08271 05B

STARLY, VIRGINIA "VIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL MOISTURE, W69-08433 021

STANLEY, A. GLACIER BASS-BALANCE HEASUREHENTS--A MANUAL FOR FIELD AND OFFICE WORK, W69~08227

AUTHOR INDEX

STRELE, TIMOTHY
DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF
SURFACE WATER IN A SMALL WATERSHED,
07C

STRELKOFF, THEODOR
ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL PLOW,
W69-08589
02E

STURGES, DAVID L.

WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG, #69-08455

RYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, W69-08456

GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BO., W69-0845 058

EVAPOTRANSPIRATION AT A WYOMING MOUNTAIN BOG,

ST, PERCY P.
TREATMENT OF HIGH NITRATE WATERS,
W69-08228 05

SUGAWARA, MASAMI
ON A METHOD OF PLOOD FORECASTING USING A DIGITAL COMPUTER CONNECTED WITH A WEATHER RADAR, 02A #69-08229

SUGAWARA, 8.
A COMPARATIVE AWALTSIS OF DIGITAL AND AWALOG COMPUTERS AS TO THEIR EFFECTIVENESS IN SOLVING RUNOFF AWALYSIS, 02A

SUMMEROUR, CHARLES
AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA RIVER,
W69-08399
066

SUNDIN, ROBERT E.
GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, U69-08457

SVANIDZE, G. G.
USE OF DIGITAL COMPUTERS FOR MATHEMATICAL MODELLING OF
HTDROLOGICAL PROCESSES,
W69-08624
07C

SYOBODA, G. R. WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968, W69-08588 02P

SZEICZ, G.
SURFACE RESISTANCE OF CROP CANOPIES,
W69-08573 02D

SZESZTAY, K.
SOME PROBLEMS OF STREAMFLOW FORECASTS BASED ON INFORMATION
THEORY,
869-08241

TABLER, ROHALD D.
PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS,
03B

SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-D, W69-08460 021

TAKAHASHI, S.
GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN (JAPANESZ),
469-08248 02F *

TAMERS, M. A. SURFACE-WATER INFILTRATION AND GROUNDWATER MOVEMENT IN ARID ZONES OF VENEZUELA, 04B

TEBO, L. B.

BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS
IN THE ROSS BARNETT RESERVOIR,

#69-08563

TERRILL, J. G., JR.
PUBLIC HEALTH FACTORS IN REACTOR SITE SELECTION,
W69-08216
05G

THOMANM, ROBERT V.

MATHEMATICAL HODEL FOR DISSOLVED OXYGEN,
W69-08532 05D

THOMAS, JEROHE F.

ODOROUS COMPOUNDS IS WATURAL WATERS-2-EXO-HYDROXY-2HETHILBORNARE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL
ACTINOMICETES,
M69-08219

05a

THOMAS, R. E. SOIL RESPONSE TO SEWAGE EFFLUENT IRRIGATION, W69-08616 05D

THOMAS, R. L. A MOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO SEDIMENTS, W69-08586

02J

THOMPSON, J. R.
SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN
COLORADO,
W69-08468
021

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED, W69-08479

TIPPANY, MARY A. NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES, $$\rm M69{-}08562$$

TIMMONS, DONALD R.
YIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN
AT FOUR LEVELS OF SOIL MOISTURE,
W69-08433

TIMMONS, JOHN F. WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS, $u_69-0.8390 \hspace{1cm} 0.06\,D$

TING, ROBERT Y.

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGROSE ANCHOVY (ANCHOW LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD HEREING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA FLABELLUM LAMOUROUX), W69-08525

TI-FAN, HUANG
PALEOLIMMETIC SALINITY OF DZUNGAR AND ORDOS BASINS,
W69-08594
02H

TOLLEY, G. S.
FUTURE ECORONICS RESEARCH ON WESTERN WATER RESOURCES -- WITH
PARTICULAR REFERENCE TO CALIFORNIA,
W69-08383
068

TRELEASE, WILLIAM
THE "WORKING" OF THE MADISON LAKES,
M69-08283 02H

VANCE, B. DWAIN
BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,
469-08565 05C

VANDERTULIP, JOHN J.
RETURN PLOWS A REUSABLE WATER RESOURCE,
W69-08259 05D

VEATCH, J. O.
LAKE TERMINOLOGY WATER BLOOM,
W69-08279 050

VELZ, C. J. PORECASTING HEAT LOSS IN PONDS AND STREAMS, W69-08415

VERMA, B. P.
A NONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND CANALS,
W69-08398
08B

VIPARELLI, M.
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE,
W69-08258
02J

VOEGELI, PAUL T., SR.
GEOLOGY AND HUDROLOGY OF THE PROJECT RULISON EXPLORATORY
HOLE, GARFIELD COUNTY, COLORADO,
W69-08596
02F

WAITT, FRANK W. P.
SISTEMATIC VARIATION PATTERN OF ANNUAL RIVER PLOWS,
W69-08591 02E

HALLIS, JAMES R.
AN APPLICATION OF MULTIVARIATE ANALYSIS TO SEDIMENT NETWORK DESIGN,
07A
07A

MULTIVARIATE STATISTICAL METHODS IN HYDROLOGY-A COMPARISON USING DATA OF KNOWN PUNCTIONAL RELATIONSHIP, W69-08499 07B

Some interpretations of Sediment sources and causes, pacific coast basins in oregon and california, $$02\mbox{\ensuremath{\mathtt{A}}}$$

WHEN IS IT SAFE TO EXTEND A PREDICTION EQUATION--AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS, W69-08509

WALTERS, L. C.
BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS
IN THE ROSS BARNETT RESERVOIR.
W69-08563
05B

PARD, R. C.
PRINCIPLES OF HYDROLOGY,
W69-08628 02A

WARREN, CHARLES E.
EXPERIMENTS ON THE DISSOLVED OXIGEN REQUIREMENTS OF COLD-WATER PISHES,
W69-08516
05C

WARRICK, A. W.

AUTHOR INDEX

TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS,

WAR-ZOR

WATSON, ALVIN C. A PROPOSED PARTNERSHIP COMPACT FOR OUR NATION'S RIVER, #69-08487 068

WATT, J. P. C. STREAMFLOW VOLUMES AND HYDROGRAPHS BY PLUORESCENT DYES, W69-08480 07B

WAUGH, T. C.
PP. MN. NI, CO. SR. LI. ZM. AND SILICA IN STREAMS OF THE LOWER KANSAS HIVPR BASIN.
UNG9-08204
05a

WFAVER, C. L.
PUBLIC HFALTH FACTORS IN REACTOR SITE SELECTION,
969-08216 05G

WEAVER, H. A.
SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION
FROM WARM SEASON PRPENNIAL FORAGE SPECIES,
W69-08026
020

WERER, RENEST H.
CALLFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN
MANAGEMENT STUDIES,
M69-08235
04B

WEEKS, W. F.
THE EFFECTS OF THERMAL POLLUTION ON RIVER-ICE CONDITIONS, W69-08422 05C

WPIR, J. S.
SEASONAL VARIATION IN ALKALINITY IN PARS IN CENTRAL AFRICA,
W69-08301
03C

WELANDER, A. D.
DISTRIBUTION OF RADIONUCLIDES IN THE ENVIRONMENT OF ENIMETOK
AND BIKINI ATOLS, AUGUST 1964,
W69-08269
05C

WFLLS, DAN M.
GROUNDWATER RECHARGE WITH TREATED HUNICIPAL EFFLUENT, W69-08620 05D

NFISH, J. G. COMPUTATIONAL ANALYSES OF MOISTURE PLUX OVER NORTH AMERICA, W69-08244 OZB

WENDLEP, GERD
HEAT BALANCF STUDIES DURING AN ICE-FOG PERIOD IN PAIRBANKS,
ALASKA,
M69-08198

WEST, ALLAN J.

SHOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND DRY YEARS,

469-08500

02C

WEST, J. A.
THE WORKMAN CREEK EXPERIMENTAL WATERSHED,
M69-08473
03B

WHETSTONE, GEORGE A.
POTENTIAL RRUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN,
W69-08262 05D

WHITE, D. E.
GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS, W69-08288 02F

WIEDEMANN, HARTMUT U.
SOLUTIONS IN INTERTIDAL AND SUPRATIDAL ENVIRONMENTS OF MODERN CARBONARP SEDIMENTATION THEIR IMPLICATION ON DIAGENESIS, W69-08218 02K

WIEGEL, R. L. SURFACE DISCHARGE OF HORIZONTAL WARK-WATER JET, M69-08421 05B

WILLEN, DOWALD W.
SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY
CHARACTERISTICS OF SOME SOUTHERN SIERRA-NEVADA POREST SITES,
W69-08513
02G

WILLIAMS, PETER F.
THE SPOINENTOLOGY OF A BRAIDED RIVER,
R69-08580 92J

WILLIAMS, RICHARD B.

THE POTENTIAL IMPOSTANCE OF SPARTINA ALTERNIPLORA IN
CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE FOOD
CHAINS,
W69-08277

WILLIS, J.
INPLUENCE OF ENVIRONMENTAL PACTORS ON THE CONCENTRATIONS OF ZN-65 BY AN PEPPRIMENTAL COMMUNITY, W69-08267

WILSON, CHARLES W.
A TECHNICAL AND ECONOMIC PEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EPPLUENT FOR IRRIGATION, W69-08623

WILSON, H. A.
SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE
WATER,
W69-08400

WILSON, J. R.
DESALINATION-POWER PLANT PROVES ECONOMICALLY PEASIBLE,
W69-08295
03A

WINCHESTER, JOHN W.
NATURAL AND POLLUTION SOURCES OF IODINE, BROMINE, AND CHLORINE IN THE GREAT LAKES,
W69-08562
05A

#ISMER, D. A.
INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND
MULTILEVEL OPTIMIZATION,
W69-08550
02P

WITZEL, S. A.
PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN
WISCONSIN,
WS-08205
05B

WOLPE, DOUGLAS A.
ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE MOLLUSCS
FROM THE LOWER TRENT AND NEUSE RIVERS,
469-08527

WOLLACK, ANNE
STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL
ANALYSES OF A CORE FROM LINSLEY POND, NORTH BRANFORD,
W69-08521
02H

WOLMAN, ABEL FUTURE WATER SUPPLY OF METROPOLITAN WASHINGTON REGION. REPORT NO 1, REQUIREMENTS AND SOURCES, W69-08257

YAMAMOTO, TERUO
ERODIBILITY INDICES FOR WILDLAND SOILS OF OAHU, HAWAII, AS
RELATED TO SOIL FORMING FACTORS,
M69-08482
02J

RAINFALL AND STREAMPLOW FROM SMALL TREE-COVERED AND PERN-COVERED AND BURNED WATERSHEDS IN HAWAII, W69-08510 02G

YEW, ALAN P.
CRUSHED LIMESTONE BARRIERS A BASIC PEASIBILITY STUDY IN
THE NEUTRALIZATION OF ACID STREAMS,
W69-08376 5G

YEN, Y. C.
THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS, #69-08422 05C

TERRE, THEODORE B.

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SHALL GROUPS OR INDIVIDUALS, W69-08511

YOUNG, CORTLAND E., JR.
FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN, W69-08437 044

STREAMPLOW - AN IMPORTANT PACTOR IN POREST MANAGEMENT IN THE COASTAL PLAIN, w69-08439 02E

HYDROLOGY OF WETLAND FOREST WATERSHEDS, W69-08440 04A

WATER TABLE, SOIL MOISTURE, AND OXIGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, #69-08443 044

YOUNG, D. B.
AN ESTIMATE OF THE RESPONSE BATE OF ALBACORE TO CESIUM, W69-08271 05B

YOUNG, G. K.
CHINKING UP SOME CRACKS,
W69-08539

U, TUN-SHENG
UNSTEADY FLOW IN A RESERVOIR-CONDUIT SYSTEM,
W69-08202

ZATTERA, A.

A COMPARISON BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA, M69-08275

05C

ZORICH, T. 8. STREAMFLOW VOLUMES AND HYDROGRAPHS BY FLUORESCENT DIES, W69-08480 078

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH SERVICE, CHICKASHA, OKLA. SOUTHERN PLAINS BRANCH.
APPLICATIONS OF COMPUTER TECHNOLOGY TO HYDROLOGIC MODEL AGRICULTURAL RESEARCH SERVICE, OXFORD, MISS. SEDIMENTATION SAMPLING AND ANALYSIS OF COARSE RIVERBED SEDIMENTS, AGRICULTURAL RESEARCH SERVICE, THORSBY, ALA. SOIL AND WATER CONSERVATION RESPARCH DIV. AND ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN. EFFECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOLSEASON FORAGE SPECIES, 021 SOIL MOISTURE REGIME EFFECT ON YIELD AND EVAPOTRANSPIRATION FROM WARE SEASON PERENNIAL FORAGE SPECIES, W69-08426 EFFECTS OF SOIL MOISTURE REGINE ON YIELD AND EVAPOTRANSPIRATION FROM COOL-SEASOR PERENNIAL FORAGE EVAPOTRANSPIRATION BY IRRIGATED CORN, EFFECTS OF SOIL MOISTURE REGIME ON YIELD, NUTRIENT CONTENT, AND EVAPOTRANSPIRATION OF THREE ANNUAL FORAGE SPECIES, W69-08429 EFFECT OF MOISTURE REGIME AND STAGE OF PLANT GROWTH ON MOISTURE USE BY COTTON, 02D MOISTURE USE BY VARIOUS PLANT SPECIES AND ITS RELATION TO PAN EVAPORATION, AND NET RADIATION, MOISTURE USE BY FORAGE SPECIES AS RELATED TO PAN EVAPORATION AND NET RADIATION, W69-08432 TIELD AND MIMERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL MOISTURE, 021 EFFECT OF PLASTIC MULCH, HERBICIDE, AND TILLAGE ON HOISTURE USE AND TIELD OF CORN, W69-08434 AGRICULTURAL RESEARCH SERVICE, TUCSON, ARIZ. SOUTHWEST WATERSHED RESEARCH CENTER.

THE ASSISTANCE OF DIGITAL COMPUTERS IN HYDROLOGIC RESEARCH AND ITS CONSEQUENCES,
W69-08233 VARIATIONS IN PRECIPITATION FROM THUNDERSTORMS IN THE SOUTHWEST, W69-08309 ALASKA UHIV., COLLEGE. GEOPHYSICAL INST.
HEAT BALANCE STUDIES DURING AN ICE-FOG PERIOD IN FAIRBANKS, ALL-UNION RESEARCH INST. OF MARINE FISHERIES AND OCEANGGRAPHY, MOSCOW (USSE).

NEW DATA ON GEOMORPHOLOGY AND RECENT SEDIMENTS OF THE BERING SEA AND THE GULF OF ALASKA, 02J AMERICAN BAR ASSOCIATION, CHICAGO, ILL.

NORTH AMERICAN WATER SUPPLY PROBLEMS AND THEIR SOLUTION,

W69-08380

O68 AMERICAN STANDARD INC., WEW BRUNSWICK, N. J. REVERSE OSMOSIS MEMBRANE REGENERATION, W69-08395 03A AMERICAN TEXTILE MANUPACTURES INST., CHARLOTTE, N. C. AND BURLINGTON INDUSTRIES, INC., GREENSBORO, N. C. WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY, W69-08552

ARIZONA STATE DEPT. OF HEALTH, PHOENIX.
WASTEWATER REUSE AT THE GRAND CANYON, W69-08290 ARIZONA UNIV., TUCSON. DEPT. OF AGRONOMY.
COMPARISON OF HATERIALS FOR REDUCING EVAPORATION OF SOIL
MOISTURE IN WATER EFFICIENCY STUDIES,
0.2D ARMY TEPRESTRIAL SCIENCES CENTER, HANGYER, N. J.
THE PEPECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS,
W69-08422
05C BAGHDAD UNIV. (IRAQ). DEPT. OF GEOLOGY.
GROUND WATER OF THE WESTERN DESERT IN IRAQ. BATTELLE-HORTHWEST, RICHLAND, WASH.
HATHEMATICAL PROGRAMMING ANALYSIS OF REGIONAL WATER-RESOURCE

BATTELLE-NORTHWEST, RICHLAND, WASH. WATER RESOURCES SYSTEMS SECTION.
THERMAL DISCHARGES REQUIRE ADVANCE PLANNING,

BUREAU OF COMMERCIAL PISHERIES, BEAUFORT, M. C.
RADIOBIOLOGICAL LAB.
IMPLUENCE OF ENVIRONMENTAL FACTORS ON THE CONCENTRATIONS OF
ZN-65 BY AN EXPERIMENTAL COMMUNITY,
M69-08267
05C

TRANSPER OF ZN-65 AND CR-51 THROUGH AM ESTUARINE FOOD CHAIN,

THE POTENTIAL IMPORTANCE OF SPARTINA ALTERNIPLORA IN CONVEYING ZINC, MANGANESE, AND IRON INTO ESTUARINE POOD

ACCUMULATION OF PALLOUT RADIOISOTOPES BY BIVALVE HOLLUSCS PROM THE LOWER TRENT AND NEUSE RIVERS, 05C

BUREAU OF COMBERCIAL FISHERIES, WASHINGTON, D. C. RESOURCE BURGEAU OF COMBRICATE STATES OF AQUATIC COMMUNITIES WITH THE EXPANDING NUCLEAR POWER INDUSTRY, W69-08420 05C

BURNS AND ROE, INC., ORADELL, H. J. ENVIRONMENTAL ASPECTS OF THERMAL STATION DESIGN,

CALIFORNIA INST. OF TECH., PASADENA.
SELECTIVE WITHDRAWAL FROM DENSITY - STRATIFIED RESERVOIRS,
W69-08419 05C

TURBULENT BOUYANT JETS INTO STRATIFIED OR PLOWING AMBIENT

NUMERICAL SOLUTIONS OF TURBULENT BOUTANT JET PROBLEMS,

CALIFORNIA STATE DEPT. OF PUBLIC HEALTH, BERKELEY. BUREAU OF SANITARY ENGINEERING. RATIONALE OF STANDARDS FOR USE OF RECLAIMED WATER,

CALIFORNIA STATE DEPT. OF WATER RESOURCES.
CALIFORNIA'S DIGITAL COMPUTER APPROACH TO GROUNDWATER BASIN
MANAGEMENT STUDIES,

CALIFORNIA STATE DEPT. OF WATER RESOURCES. ADVANCED CALIFORNIA STATE DEPT. OF WATER RESOURCES. ADVANCED TECHNIQUES SECTION. APPLICATION OF COMPUTERIZED OPERATIONS RESEARCH TECHNIQUE FOR OPTIMUM ECONOMIC SIZING OF THE MIDDLE FORK EEL RIVER PROJECT, U69-08240

CALIFORNIA UNIV., BERKELEY. COL. OF ENGINEERING AND CALIFORNIA UNIV., BERKELEY. DEFT. OF CHEMISTRY. ODOROUS COMPOUNDS IN NATURAL WATERS-2-EXO-HYDROXY-2-METHYLBORNANE, THE ODOROUS COMPOUND PRODUCED BY SEVERAL

CALIFORNIA UNIV., DAVIS, DEPT. OF CIVIL ENGINEERING.
THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS,
W69-08621

CALIFORNIA UNIV., DAVIS.
ANTITRANSPIRANTS RESEARCH AND ITS POSSIBLE APPLICATION IN

CALIFORNIA UNIV., DAVIS. DEPT. OF BOTANY.
POTENTIAL EVAPOTRANSPIRATION AND PLANT DISTRIBUTION IN
WESTERN STATES WITH EMPHASIS ON CALIFORNIA,
W69-08308
02D

CALIFORNIA UNIV., DAVIS. DEPT. OF WATER SCIENCE AND ENGINEERING.
COMPARISON BETWEEN RAIN GAGE AND LYSIMETER MEASUREMENTS.
028

ONE-DIMENSIONAL EQUATIONS OF OPEN-CHANNEL PLOW,

CALIFORNIA UNIV., LOS ANGELES.
OPTIMAL IDENTIFICATION OF LUMPED WATERSHED HODELS,
W69-08570 02A

CALIPORNIA UNIV., LOS ANGELES. DEPT. OF ENGINEERING.
INDENTIFICATION OF AQUIPER PARAMETERS BY DECOMPOSITION AND
MULTILEVEL OPTIMIZATION,
M69-08550

02P

CALIFORNIA UNIV., LOS ANGELES. WATER RESOURCES CENTER.
OPTINUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES

CALIFORNIA UNIV., RIVERSIDE.
WATER RELEASE AS A SOIL PROPERTY RELATING TO USE OF WATER BY PLANTS 03F

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOILS AND PLANT NITRITION.

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER BELATIONS IN PLANTS IV. THE COMPENSATION OF OSMOTIC AND HYDROSTATIC WATER POTENTIAL DIFFERENCES BETWEEN ROOT XYLEM AND EXTERNAL MEDIUM, W69-08291

CALIFORNIA UNIV., SAN DIEGO, LA JOLLA. INST. OF MARINE PESOURCES.

ALGAE AMOUNTS OF DNA AND ORGANIC CARBON IN SINGLE CELLS, ₩69-08278

CAMBRIDGE UNIV. (ENGLAND). SCHOOL OF AGRICULTURE.

THE VERTICAL MOVEMENT OF WATER IN STRATIFIED POROUS
MATERIAL. 2. TRANSIENT STAGES OF DRAINAGE TO A WATER TABLE, W69-08203

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
OPTIMAL TAXING FOR THE ABATEMENT OF WATER POLLUTION, W69-08547 OFF

CELULOSA Y DERIVADOS S.A., MONTERREY (MEXICO). COPROPIEDAD GRUPO QUIMICO.
WATER REUSE IN MONTERREY, MEXICO,

05D

W69-08289

CENTRAL ELECTRICITY GENERATING BOARD, BARNET (ENGLAND).
RESPARCH AND DEVELOPMENT DEPT.
CHEMICAL CHANGES IN COOLING WATER TOWERS,
W69-08402
058

CHUO UNIV., TOKYO (JAPAN).
DIFFUSION OF WARM WATER JETS DISCHARGED HORIZONTALLY AT THE SURFACE, W69-08412

COLD REGIONS RESPARCH AND ENGINEERING LAB., HANOVER, N. H. SNOW ACCUMULATION ON MOUNT LOGAN, YUKON TERRITORY, CANADA. M69-08207

COLORADO STATE UNIV., PORT COLLINS.

EFFECTS OF HURRICANE STORMS ON AGRICULTURE,
W69-08568

COLORADO UNIV., DENVER. DEPT. OF MICROBIOLOGY.
SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS,

COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, LA SPEZIA (ITALY).
A COMPARISON BETWEEN THE UPTAKE OF RADIOACTIVE AND STABLE ZINC BY A MARINE UNICELLULAR ALGA, M69-08275 05C

CORPS OF ENGINEERS MEMPHIS, TRNN.
PLOOD PLAIN INFORMATION OF NORTH FORK OBION RIVER, HOOSIER
AND GROVE CREEKS, UNION CITY, TENNESSEE.
M69-08247
04A

CORPS OF ENGINEERS, ATLANTA, GA.
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF
ENGINEERS IN ALABAMA.

CORPS OF ENGINEERS, ATLANTA, GA. SOUTH ATLANTIC DIV. WATER RESOURCES DEVFLOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN GEORGIA. W69-08225

CORES OF EMGINEERS, CINCINNATI, OHIO. OHIO RIVER DIV.
WATER RESOURCES DEVELOPMENT BY THE U. S. ARMY CORPS OF
EMGINEERS IN INDIANA.

ORPS OF ENGINEERS, NORPOLK, VA. FLOOD PLAIN INFORMATION, UPHAN BROOK, HENRICO, VIRGINIA. W69-08610

CORPS OF ENGINEERS, OMAHA, NEBR.
PLOOD PLAIN INFORMATION OF BARDEN CREEK, CASPER, WYOMING-VOLUME 1. W69-08224

CORPS OF ENGINEERS, PHILADELPHIA, PA. †
FLOOD PLAIN INFORMATION, TIDAL LANDS OF CAPE MAY COUNTY, NEW
JERSEY.

CORPS OF ENGINEERS, PORTLAND, OREG. NORTH PACIFIC DIV.

APPLICATION OF STREAMFLOW SYNTHESIS AND RESERVOIR REGULATION

"SSAR"-PROGRAM TO THE LOWER MEKONG RIVER,

W69-08246 02E

CORPS OF EMGINEERS, PORTLAND, OREG., NORTH PACIFIC DIV. WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN IDAMO.

CORPS OF ENGINEERS, SACRAMENTO, CALIP. HYDROLOGIC PHGINPERING CENTER. HYPOTHETICAL PLOOD COMPUTATION FOR A STREAM SYSTEM,

ECONOMIC EVALUATION OF RESERVOIR SYSTEM ACCOMPLISHMENTS.

869-08543

CORPS OF ENGINEERS, VICKSBURG, MISS. LOWER MISSISSIPPI VALLEY DIV.
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARKANSAS. W69-08602

06 B

CORPS OF ENGINERRS, WILHINGTON, W. C.
PLOOD PLAIN INFORMATION NEUSE AND TRENT RIVERS AND JACK
SMITH CREEK, NEW BERN, NORTH CAROLINA.
04A

DARTHOUTH COLL., HANOVER, N. H. DEPT. OF BIOLOGICAL SCIENCES AND ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, N.

MEASUREMENTS OF BACKGROUND RADIATION IN AQUATIC HABITATS IN ALASKA, W69-08272 05C

DELAWARE RIVER BASIN COMMISSION, TRENTON, N. J. WATER QUALITY BEANCH.
REGIONAL WATER QUALITY STANDARDS,
M69-08213
05G

DELAWARE UNIV., NEWARK. URBAN AFFAIRS DIV.
A TEST OF THE HYPOTHESIS THAT POLLUTION CONTROL IS WORTH WHAT IT COSTS,

DEPARTMENT OF COMMERCE, WASHINGTON, D. C.
BETTER MANAGEMENT OF WATER RESOURCES IS A MUST IF FUTURE
NERDS ARE TO BE HET,
W69-08557
05G

DEPARTMENT OF ENERGY, MINES AND RESOURCES, BURLINGTON (OWTARTO). CANADA CENTRE FOR INLAND WATERS. A NOTE ON THE RELATIONSHIP OF GRAIN SIZE, CLAY CONTENT, QUARTZ AND ORGANIC CARBON IN SOME LAKE ERIE AND LAKE ONTARIO

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO) AND NORWEGIAN WATER RESOURCES BOARD, OSLO. GLACIER MASS-BALANCE MEASUREMENTS--A MANUAL FOR PIELD AND OFFICE WORK, ¥69-08227

DEPARTMENT OF ENERGY, HINES AND RESOURCES, OTTAWA (ONTABIO) AND MCGILL UNIV., MONTREAL (QUEBEC).

DIGITAL COMPUTER APPLICATIONS TO GREAT LAKES REGULATION, w69-08242

DEPARTMENT OF TRANSPORT, TORONTO (ONTABIO). METEOROLOGICAL BRANCH.
PRECIPITATION IN NORTHERN QUEBEC AND LABRADOR AN EVALUATION OF MEASUREMENT TECHNIQUES,
02B

DOHRMANN INSTRUMENTS CO., MOUNTAIN VIEW, CALIF.
DETERMINATION OF TOTAL NITROGEN IN WATER BY MICROCOULOMETRIC TITRATION,

DREXEL INST. OF TECH., PHILADELPHIA, PA. SIMILARITY APPROXIMATION FOR THE RADIAL SUBSURFACE PLOW PROBLEM W69-08575

DU PONT DE NEMOURS (E. I.) AND CO., AIKEN, S. C. SAVANNÀH RIVER LAB.
TRACING GEOUNDWATER WITH CHLORIDE IONS AND TRITIUM THROUGH ACID KAOLINITIC SOIL,

ECONOMIC RESEARCH SERVICE, WASHINGTON, D.C. RESOURCE DATA SYSTEMS GROUP.
DATA SYSTEMS AND INPORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,

W69-08286

ECONOMIC RESEARCH SERVICE, WASHINGTON, D.C. AND COLORADO STATE UNIV., FORT COLLINS.
WINDFALL GAINS PROM TRANSPER OF WATER ALLOTHENTS WITHIN THE COLORADO-BIG THOMPSON PROJECT,

EUGENE WATER AND ELECTRIC BOARD, OREG.
WARM-WATER IRRIGATION AN ANSWER TO THERBAL POLLUTION,

PEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CHICAGO, ILL. GREAT LAKES REGION.
AN APPRAISAL OF WATER POLLUTION IN THE LAKE SUPERIOR BASIN.

PEDERAL WATER POLLUTION CONTROL ADMINISTRATION, PRESNO, CALIF. SAN JOAQUIN PROJECT AND STANFORD UNIV., CALIF. DEPT. OF ENVIRONMENTAL ENGINEERING.
TREATMENT OF HIGH NITRATE WATERS, 05 D

PEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D. C. RESEARCH COMMITTEE.
A REVIEW OF THE LITERATURE OF 1968 ON WASTEWATER AND WATER POLLUTION CONTROL.
W69-08199
05D

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D. C. DIV. OF TECHNICAL CONTROL. CHINKING UP SOME CRACKS,

PEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, PEDERAL ASSISTANCE AVAILABLE TO COMPANIES ESTABLISHING

POLLUTION CONTROL PROGRAMS,

PERRARA UNIV. (ITALY). INST OF GEOLOGY.

PEBBLE CLUSTERS THEIR ORIGIN AND UTILIZATION IN THE

STUDY OF PALAEOCURRENTS,

PINNISH HYDROLOGICAL OFFICE, HELSINKI.
DROUGHTS IN FINNISH WATERCOURSES WITH REFERENCE TO WATER
SUPPLY AND POLLUTION CONTROL (FINNISH).
02E

PLONIDA STATE UNIV., TALLAHASSEE. DEPT. OF GEOLOGY.
ELECTRON MICROSCOPY OF CHEMICAL SOLUTION AND MECHANICAL
ABRASION FEATURES ON QUARTZ SAND GRAINS,

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING.

NITROGEN PIXATION IN SOME ANOXIC LACUSTRINE ENVIRONMENTS,

FLORIDA UNIV., GAINESVILLE. INST. OF FOOD AND AGRICULTURAL SCIENCES.

06B W69-08392

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. CHAD BASIN COMMISSION.

A HYDROLOGICAL SYNTHESIS OF THE CHAD BASIN,

POREST SERVICE (USDA) TEMPE, ARIZ. BOCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION.

EROSION AND SEDIMENT MOVEMENT FOLLOWING A WILDFIRE IN A PONDERGY PINE FOREST OF CENTRAL ARIZONA,

FOREST SERVICE (USDA), ALBUQUERQUE, N. MEX. ROCKY HOUNTAIN FOREST AND RANGEEXPERIMENT STATION. MOISTURE LOSS AND WEIGHT OF THE FOREST FLOOR UNDER POLE-SIZE PONDERGS A PINE STANDS,

POREST SERVICE (USDA), ALBUQUERQUE, M. MEX. BOCKY HOUNTAIN FOREST AND RANGE EXPERIMENT STATION. SUMMER DEPERRED GRAZING CAN IMPROVE DETERIORATED SEMIDESERT

DEFERRED GRAZING AND SOIL RIPPING IMPROVES FORAGE ON NEW MEXICO'S RIO PUPRCO DRAINAGE, 04A

DETRIMENTAL EPPECT OF RUSSIANTHISTLE ON SEMIDESEET RANGE IN WEST-CENTRAL NEW MEXICO,

469-08464

PRODUCTION CAPABILITIES OF SOME UPPER RIO PUERCO SOILS OF

INPLUENCE OF TEMPERATURE ON THE GERMINATION OF SOME RANGE

FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION.
SOIL SLIPS RELATED TO VEGETATION, TOPOGRAPHY, AND SOIL IN SOUTHERN CALIFORNIA, 02G

ERODIBILITY INDICES FOR WILDLAND SOILS OF OAHY, HAWAII, AS RELATED TO SOIL FORMING FACTORS,

USE OF MUCLEAR TECHNIQUES IN SHOW AND RELATED WATERSHED MANAGEMENT, W69-08496

AN APPLICATION OF HULTIVARIATE ANALYSIS TO SEDIMENT NETWORK 869-08497

MANAGING CALIFORNIA'S SNOW ZONE LANDS FOR WATER,

MULTIVARIATE STATISTICAL HETHODS IN HYDROLOGY-A COMPARISON USING DATA OF KNOWN PUNCTIONAL RELATIONSHIP, 869-08499 07B

SHOW ACCUMULATION AND MELT IN RELATION TO TERRAIN IN WET AND DRY YEARS, #69-08500

SOME INTERPRETATIONS OF SEDIMENT SOURCES AND CAUSES, PACIFIC COAST BASINS IN OREGON AND CALIFORNIA, 02A

SUMBARY OF FORESTS AND SOIL STABILIZATION SESSION, W69-08502 (ND

INTEGRATING SHOW ZONE BANAGEMENT WITH BASIN HAWAGEMENT,

FED-FOL WATERSHED MODELING APPROACH TO EVALUATION OF THE HYDROLOGIC POTENTIAL OF UNIT AREAS, W69-08504

GENERAL REPORT SYMPOSIUM SUBJECT NEW IDEAS AN METHODS IN STOCHASTIC (STATISTICAL) HYDROLOGY, W69-08505 07B NEW IDEAS AND SCIENTIFIC

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA, W69-08506

EROSION AND SEDIMENTATION, W69-08507

023

WHEN IS IT SAPE TO EXTEND A PREDICTION EQUATION--AN ANSWER BASED UPON FACTOR AND DISCRIMINANT FUNCTION ANALYSIS, W69-08509

RAINFALL AND STREAMFLOW FROM SHALL TREE-COVERED AND PERN-COVERED AND BURNED WATERSHEDS IN HAWAII, W69-08510 02G

COMPUTER DOCUMENTATION AND RETRIEVAL OF HYDROLOGIC INFORMATION FOR SHALL GROUPS OR INDIVIDUALS,

-- USERS OF WATER,

SURFACE SOIL TEXTURE AND POTENTIAL ERODIBILITY CHARACTERISTICS OF SOME SOUTHERN SIERBA-NEVADA FOREST SITES,

POREST SERVICE (USDA), CHARLESTON, S. C. SOUTHEASTERN FOREST EXPERIMENT STATION.

DRAINAGE, #69-08438

STREAMPLOW - AN IMPORTANT PACTOR IN FOREST MANAGEMENT IN THE COASTAL PLAIN, W69-08439

HYDROLOGY OF WETLAND POREST WATERSHEDS.

SOILS INFORMATION USED AND NEEDED FOR WOODLAND PRODUCTION RESEARCH FINDINGS - ORGANIC SOILS, W69-08441

WIND DAMAGES IMPROPERLY PLANTED SLASH PINE,

WATER TABLE, SOIL HOISTURE, AND OXIGEN DIFFUSION RELATIONSHIPS ON TWO DRAINED WETLAND FOREST SITES, W69-08443

POREST SERVICE (USDA), CHARLESTON, S. C. SOUTHEASTERN FOREST EXPERIMENT STATION. FOREST DRAINAGE RESEARCH IN THE COASTAL PLAIN,

FOREST SERVICE (USDA), FLAGSTAFF, ARIZ. BOCKY HOUHTAIN
FOREST AND RANGE EXPERIMENT STATION.
OBSERVATIONS OF SHOWPACK ACCUMULATION, HELT, AND RUNOFF ON A
SHALL ARIZONA WATERSHED,

OBSERVATIONS OF SNOW ACCUMULATION AND HELT IN DEMONSTRATION CUTTINGS OF POWDEROSA PINE IN CENTRAL ARIZONA, W69-08494

POREST SERVICE (USDA), PORT COLLINS, COLO. ROCKY ROUNTAIN FOREST AND RANGE EXPERIMENT STATION. AVALANCHE TECHNOLOGY AND RESEARCH, RECENT ACCOMPLISHMENTS FUTURE PROSPECTS,

SNOW AVALANCHES ALONG COLORADO MOUNTAIN HIGHWAYS, W69-08445

SNOW COVER AND AVALANCHES IN THE HIGH ALPINE ZONE OF WESTERN UNITED STATES, W69-08446

A MABUAL FOR PLANNING STRUCTURAL CONTROL OF AVALANCHES, $69 \hbox{--}08447$

THE WEATHER AND CLIMATE OF A HIGH MOUNTAIN PASS IN THE COLORADO ROCKIES, W69-08448

AN EXAMPLE OF DAMAGE FROM A POWDER AVALANCHE, N69-08449 02C

IMPLUENCE OF GAP WIDTH BELOW A VERTICAL SLAT SHOW PENCE ON SIZE AND LOCATION OF LEE DRIFT, 02C

SOME OBSERVATIONS ON TEMPERATURE PROFILES OF A MOUNTAIN SHOW COVER, W69-08451

ATHOSPHERIC HUMIDITY HEASUREMENT MEAR THE SHOW SURFACE,

SOME REASUREMENTS OF AIR PERMEABILITY IN A MOUNTAIN SNOW COVER, W69-08453

AREAL EXTENT OF SHOW COVER IN RELATION TO STREAMFLOW IN

POR-GEO CENTRAL COLORADO, W69-08454 0.20 STREAMPLOW VOLUMES AND HYDROGRAPHS BY PLUORESCENT DYES, WATERSHED TREATMENT EFFECTS ON EVAPOTRANSPIRATION, POSSIBILITIES OF INCREASING STREAMPLOW FROM FOREST AND RANGE WATERSHEDS BY MANIPULATING THE VEGETATIVE COVER-THE BEAVER CREPK PILOT WATERSHED EVALUATION STUDY, 03B POREST SERVICE (USDA), LARAMIE, WIO. ROCKY MOUNTAIN POREST AND RANGE EXPERIMENT STATION.
WATER QUALITY AS AFFECTED BY A WYOMING MOUNTAIN BOG, HYDROLOGIC PROPERTIES OF PEAT FROM A WYOMING MOUNTAIN BOG, 026 GROSS ALPHA AND BETA RADIATION IN WATERS AT A WYOMING MOUNTAIN BOG, W69-08457 EVAPOTRANSPIRATION AT A WYOMING MOUNTAIN BOG, PHYSICAL AND ECONOMIC DESIGN CRITERIA FOR INDUCED SNOW ACCUMULATION PROJECTS, W69-08459 0.38 SOIL MOISTURE RESPONSE TO SPRAYING BIG SAGEBRUSH WITH 2, 4-W69-08460 POREST SERVICE (USDA), MOSCOW, IDAHO. FORESTRY SCIENCES THE GENERATION OF SPRING PEAK FLOWS BY SHORT-TERM MFTEOHOLOGICAL EVENTS, SNOW CATCH BY CONIFFR CROWNS, W69-08436 POREST SERVICE (USDA), OGDEN, UTAH. INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION.
A SIMPLE SNOWMELT LYSIMETER, W69-08206 02C FOREST SPRVICE (USDA), TEMPE, ARIZ. FOREST HYDROLOGY LAB. WATER YIELD CHANGES AFTER CONVERTING A FORESTED CATCHMENT TO W69-08200 0.3B FOREST SERVICE (USDA), TEMPE, ARIZ. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION. SUMMER WATER USE BY ASPEN, SPRUCE, AND GRASSLAND IN WESTERN A SHIELDED THERMISTOR WITH PORTABLE INSTRUMENT FOR MEASURING SHOWPACK TEMPERATURES, 07B REDUCTION OF LITTER AND SHRUB CROWNS BY PLANNED FALL BURNING OF OAK-MOUNTAINMAHOGANY CHAPARRAL, SHRUB SEEDLING REGENERATION AFTER CONTROLLED BURNING AND HERBICIDAL TREATMENT OF DRNSE PRINGLE MANZANITA CHAPARRAL, W69-08471 POREST SERVICE (USDA), TEMPE, ARIZ. BOCKY MOUNTAIN FOREST AND RANGE STATION.

PRELIMINARY WATER YIELDS AFTER TIMBER HARVEST ON CASTLE CREEK, ARIZONA WATERSHEDS,

W69-08472. 03B FOREST SERVICE (USDA), TEMPE, ARIZ. ROCKY MOUNTAIN POREST AND BANGE EXPERIMENT STATION.

THE WORKMAN CREEK EXPERIMENTAL WATERSHED, W69-08473 SURFACE RUNOFF AND EROSION IN THE LOWER CHAPARRAL ZONE, 040 GAZING IN RELATION TO RUNOFF AND EROSION ON SOME CHAPARRAL WATERSHEDS OF CENTRAL ARIZONA, 869-08876 WATER YIELDS RESULTING FROM TREATMENTS APPLIED TO MIXED CONIPER WATERSHED, W69-08477 PRELIMINARY EFFECTS OF FOREST TREE REMOVAL ON WATER YIELDS AND SEDIMENTATION, W69-08478 EFFECT OF GRAZING ON INPILTRATION IN A WESTERN WATERSHED, W69-08479

W69-08485 HELICOPTER-APPLIED HERBICIDES CONTROL SHRUB LIVE OAK AND BIRCHLEAP MOUNTAINMAHOGANY, W69-08486 MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES, PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID REGION, W69-08489 WATER TABLE CHARACTERISTICS UNDER TAMARISK IN ARIZONA, GUIDE FOR SURVEYING PHREATOPHYTE VEGETATION, W69-08491 POREST SERVICE (USDA), UPPER DARBY, PA. MORTHEASTERN EXPERIMENT STATION AND POREST SERVICE (USDA), BERKEL CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT NORTHEASTERN FOREST STATION. IMPORTANT WATERSHED CHARACTERISTICS AFFECTING WATER YIELD, PLOOD PEAKS AND EROSION AND SEDIMENTATION AND THE BASIC DATA NEEDED FOR PRODUCTION, GENERAL ELECTRIC CO., PHILADELPHIA, PA. WATER REUSE IN SPACE, W69-08261 GENERAL ELECTRIC CO., SANTA BARBARA, CALIF. TEMPO.
PREPARATION, VERIPICATION AND USE OF A DIGITAL GROUNDWATER
SIMULATION PROGRAM, GEOLOGICAL SURVEY, ARLINGTON, VA. WATER RESOURCES DIV.
REVIEW OF SURFACE WATER SYSTEMS ANALYSIS,
W69-08533
06A GEOLOGICAL SURVEY, DENVER, COLO.
ESTIMATING FORCED EVAPORATION FROM COOLING PONDS, W69-08414 GEOLOGY AND HYDROLOGY OF THE PROJECT RULISON EXPLOBATORY HOLE, GARFIELD COUNTY, COLORADO, W69-08596 02F GPOLOGICAL SURVEY, JACKSON, MISS.
GEOHYDROLOGIC SUMMARY OF THE PEARL RIVER BASIN, MISSISSIPPI AND LOUISIANA, W69-0826# GEOLOGICAL SURVEY, LAWRENCE, KANS. AND KANSAS STATE
GEOLOGICAL SURVEY, LAWRENCE.
SATURATED THICKNESS AND SPECIFIC YIELD OF CENOZOIC DEPOSITS 02F W69-08265 GEOLOGICAL SURVEY, PORTLAND, OREG. WATER RESOURCES AND DEVELOPMENT WATER RESOURCES. GEOLOGICAL SURVEY, TUCSON, ARIZ. WATER RESOURCES DIV. WATER RESOURCES INVESTIGATION IN A SEMIARID BASIN IN ARIZONA, U.S.A., W69-08299 02F INVESTIGATION OF THE GEOCHEMISTRY OF WATER IN A SEMIARID BASIN ARIZONA, U.S.A., W69-08300 GEOLOGICAL SURVEY, WASHINGTON, D. C.
DIGITAL-COMPUTER APPLICATIONS IN CHEMICAL-QUALITY STUDIES OF SURFACE WATER IN A SMALL WATERSHED, W69-08234 GEOLOGY AND GROUNDWATER OCCURRENCE IN SOUTHEASTERN ECKINLEY COUNTY, NEW MEXICO, W69-08287 GROUNDWATER RESOURCES OF UPTON COUNTY, TEXAS, A PRACTICAL FIELD TECHNIQUE FOR MEASURING RESERVOIR EVAPORATION UTILIZING MASS - TRANSPER THEORY, W69-08418 SURPACE WATER SUPPLY OF THE UNITED STATES, 1961-65 PART 6. MISSOURI RIVER BASIN. W69-08605 07C HYDROLOGIC DATA SYSTEMS -- DEVELOPING CONCEPTS, GEOLOGICAL SURVEY, WASHINGTON, D. C. WATER RESOURCES DIV. THE USE OF RESERVOIRS AND LAKES FOR THE DISSIPATION OF HEAT, W69-08406 050 GEORGIA UNIV., ATHENS. DEPT. OF GEOLOGY.
SOLUTIONS IN INTERTIDAL AND SUPPATIDAL ENVIRONMENTS OF MODERN CARBONATE SEDIMENTATION THEIR IMPLICATION OW DIAGENESIS. 028 W69-08218

BURNED CHAPARRAL TO GRASS EARLY EFFECTS ON WATER AND SEDIMENT YIELDS PRON TWO GRANITIC SOIL WATERSHEDS IN

IMPROVING WATER VIELD AND GAME HABITAT BY CHEMICAL CONTROL

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY AND NORTH CAROLINA UNIV., CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.

PHOSPHORUS TURNOVER BY CORAL REEF ANIMALS,

- GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.

 THE PHOSPHORUS AND ZINC CYCLES AND PRODUCTIVITY OF A SALT HARSH,
- GOLDSMITHS' COLL., LONDON (ENGLAND). DEPT. OF GEOLOGY AND GEOGRAPHY AND GEORGIA UNIV., SAPELO ISLAND. MARINE INST. THE SIGNIFICANCE AND LIBITATIONS OF STATISTICAL PARAMETERS FOR DISTINGUISHING ANCIENT AND HODERN SEDIMENTARY PNY IRONHENTS OF THE LOWER GEORGIA COASTAL PLAIN,
- GRUZINSKII POLITEKHNICHESKII INSTITUT, TIPLIS (USSR).
 USE OF DIGITAL COMPUTERS FOR HATHPHATICAL MODELLING OF
 HYDROLOGICAL PROCESSES,
- HARVARD SCHOOL OF PUBLIC HEALTH, BOSTON, MASS. KRESGE CENTER FOR ENVIRONMENTAL HEALTH.

 ENVIRONMENTAL PROTECTION FOR NUCLEAR APPLICATIONS,
- HARVARD UNIV., CAMBRIDGE, MASS. PORECASTS WITH VARYING RELIABILITY, W69-08545
- HARVARD UNIV., CAMBRIDGE, MASS. HARVARD WATER PROGRAM.
 AN APPLICATION OF NON-LINEAR PROGRAMMING TO THE PLANNING OF
 MUNICIPAL WATER SUPPLY SYSTEMS SOME RESULTS,
 W69-085.35
 06A
- HEYDELBERG UNIV. (WEST GERMANY) AND UNI SAARLANDES, SAARBRUECKEN (WEST GERMANY). GEOMORPHOLOGY, W69-08226 AND UNIVERSITAET DES 02B
- HOUSTON RESEARCH INST., INC., TEX.
 MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR SIMULATION AND
 OPTIMUM DESIGN OF VERTICAL TUBE EVAPORATION PLANTS FOR
 SALINE WATER CONVERSION,
- HOUSTON UNIV., TEX. DEPT. OF CHEMISTRY HOUSTON UNIV., TEX. DEPT. OF BIOLOGY AND HOUSTON UNIV., TEX. DEPT. OF BIOPHYSICAL SCIENCES.
 OLEFINS OF HIGH MOLECULAR WEIGHT IN TWO MICROSCOPIC ALGAE, W69-08284
- HULL UNIV. (ENGLAND). DEPT. OF GEOGRAPHY. PRINCIPLES OF HYDROLOGY, W69-08628
- HYDROSCIERCE, INC., LEONIA, N. J.
 TRANSFER OF OXYGEN IN AQUEOUS SOLUTIONS,
 W69-08217
 05a
- IBADAN UNIV. (NIGERIA). DEPT. OF GEOLOGY.
 A RAPID METHOD FOR THE DETERMINATION OF SHAPE, SPHERICITY
 AND SIZE OF GRAVEL PRAGMENTS,
- ILLINOIS STATE WATER SURVEY, URBANA, ILL.
 WATER USE AND RELATED COSTS WITH COOLING TOWERS,
 W69-08407 05G
- ILLINOIS UNIV., URBANA AND ILLINOIS UNIV., CHAMPAIGN.
 THEORETICAL STREAM LENGTHS AND DRAINAGE AREAS IN HORTON WETS
 OF VARIOUS ORDERS,
- ILLINOIS UNIV., URBANA.

 BASIC STUDY OF JET FLOW PATTERNS RELATED TO STREAM AND RESERVOIR BEHAVIOR,

 08B
- INDIANA UNIV., BLOOMINGTON. DEPT. OF ZOOLOGY.
 INFLUENCE OF RATE OF FEEDING ON BODY COMPOSITION AND PROTEIN
 HETABOLISH OF BLUEGILL SURFISH,
- INDUSTRIAL SCIENCE AND TECHNOLOGY AGENCY, KAWASAKI (JAPAN).
 GEOLOGICAL SURVEY.
 GROUND WATER RESOURCES IN THE KOCHI PLAIN, SOUTHWEST JAPAN
 (JAPANESE),
 NGQ-AGRAGA H69-08248
- INSTITUTE OF SYDROTECHNICAL RESEARCH, BUCHAREST (BUMANIA).
 ON THE SOLUTION OF THE PROBLEMS OF INFILTRATION WITH THE AID
 OF ELECTRONIC COMPUTERS (FRENCH),
 - SOME REMARKS ON THE USE OF DIGITAL COMPUTERS AND HYDRAULIC METHODS FOR FLOOD ROUTING AND FLOOD FORECASTING PROBLEMS, W69-08232
- INSTITUTO VENESOLANO DE INVESTIGACIONES CIENTIFICAS, CARACAS.
 CARACAS.
 SURFACE-WATER IMPILTRATION AND GROUNDWATER HOVEMENT IN ARID ZONES OF VEHEZUELA,
 869-08306
 048
- IOWA COOPERATIVE FISHERIES RESEARCH UNIT, AMES.
 POOD MABITS OF THE YELLOW BASS, ROCCUS HISSISSIPPIERSIS,
 CLEAR LAKE, IOWA, SUMMER 1962,
 W69-08515
 OSC

- IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY. TWO-DIMENSIONAL SEEPAGE OF BONDED WATER TO FULL DITCH DRAINS, W69-08576
- IOWA UNIV., IOWA CITY. COLL. OF LAW.

 OPPORTUNITIES FOR REGIONAL RESEARCH ON WATER RESOURCES
 PROBLEMS,

 W69-08393

 06B
- IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
 RECIRCULATION OF COOLING WATER IN RIVERS AND CANALS,
 W69-08416 W69-08416
 - DISPERSION OF SILT PARTICLES IN OPEN CHANNEL FLOW,
- JOHNS HOPKINS UNIV., BALTIMORE, MD. CHESAPEAKE BAY INST. OBSERVATIONS OF MOTION AT INTERMEDIATE AND LARGE SCALES IN A COASTAL PLAIN ESTUARY,
- KAISER ENGINEERS, OAKLAND, CALIF.
 DESALINATION-POWER PLANT PROVES ECONOMICALLY PEASIBLE, w69-08295 03A
- KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE AND KANSAS UNIV., THE LOWER KANSAS BIVER BASIN,
- KANSAS UNIV., LAWRENCE AND WHIRLPOOL CORP., ST. JOSEPH, MICH.
 UNSTEADY PLOW IN A RESERVOIR-CONDUIT SYSTEM,
- LEICESTER UNIV. (ENGLAND). DEPT. OF ZOOLOGY.
 SEASONAL VARIATION IN ALKALIMITY IN PANS IN CENTRAL APRICA,
 M69-08301
 03C
- LOCKWOOD GREENE ENGINEERS, INC., SPARTANBURG, S. C. THE AVAILABILITY OF QUALITY WATER IS IMPORTANT IN PICKING A W69-08553
- LOUIS KOENIG-RESEARCH, SAN ANTONIO, TEX. AND TEXAS UNIV., AUSTIN.
 REUSE CAN BE CHEAPER THAN DISPOSAL, 050
- LOUISIANA POLYTECHNIC INST., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING.
 MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION.
- LYON UNIV. (FRANCE). DEPT. OF EARTH SCIENCES. GLACIAL AND PLUVIO-GLACIAL FORMATIONS OF THE LYON REGION
- MANCHESTER UNIV. (ENGLAND).
 OH A HOMENTUM-HASS PLUX DIAGRAM FOR TURBULENT JETS, PLUMES AND WARES,
 469-08410
 08B
- MARQUETTE UNIV., MILWAUKEE, WIS. DEPT OF BIOLOGY.
 DETERMINATION OF PEEDING CHRONOLOGY IN FISHES,
 05C 05C
- MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
 A FIRST TRIAL IN OPTIMAL DESIGN AND OPERATIONS OF A WATER RESOURCE SYSTEM,
 W69-08544
 064
- MASSACHUSETTS UNIV., ANHERST.

 THE CONTROL OF GROUNDWATER OCCURRENCE BY LITHOPACIES IN THE GUADALUPIAN REEF COMPLEX NEAR CARLSBAD, NEW MEXICO,

 048
- MELBOURNE UNIV., PARKYILLE (AUSTRALIA). DEPT. OP ENGINEERING AND SCOTT AND FURPHY, NELBOURNE (AUSTRALIA). SYSTEMATIC VARIATION PATTERN OF ANNUAL RIVER FLOWS, 950-08501
- METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS, D. C. FUTURE WATER SUPPLY OF HETROPOLITAN WASHINGTON REGION. REPORT WO 1, REQUIREMENTS AND SOURCES, 06D
- MICHIGAN STATE UNIV., EAST LANSING. LARE TERMINOLOGY WATER BLOOM, W69-08279 05C
- HICHIGAN STATE UNIV., ÉAST LAUSING. DEPT OF AGRICULTURAL ECONOMICS AND MICHIGAN STATE UNIV., EAST LAWSING. DEPT. OF RESOURCES DEVELOPMENT.
 WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT, W69-08308
- MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL HEALTH. FORECASTING HEAT LOSS IN PONDS AND STREAMS, W69-08415
- BICHIGAN UNIV., ANN ARBOR. DEPT. OF HETEOROLOGY AND HICHIGAR UNIV., AND ARBOR.

 OCEANOGRAPHY.

 HATURAL AND POLLUTION SOURCES OF IODINE, BROHINE, AND
 CHLORIME IN THE GREAT LAKES,

 W69-08562

 O5A

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF PUBLIC HEALTH. THERMAL DISCHARGES, W69-08413

MINISTRY OF AGRICULTURE AND WATER, RIYADH (SAUDI ARABIA) AND FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, GROUNDWATER POTENTIAL OF KARST AQUIPERS IN SAUDI ARABIA,

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
PROPAGATION OF PLOOD WAVES IN OPEN CHANNELS,
02E

MISSISSIPPI GAME AND FISH COMMISSION, JACKSON. FISHERIES

SOME EFFECTS OF PESTICIDES ON MISSISSIPPI WATERS, W69-08222

MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF AGRICULTURAL AND BIOLOGICAL ENGINEERING.
A NONDIMENSIONAL APPROACH TO THE FLOW OF WATER IN FLUMES AND 088

MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF WILDLIFE AN ECOLOGICAL AND RECREATIONAL USE SURVEY OF THE LUXAPALILA

RIVER, W69-08399 066

MISSISSIPPI STATE UNIV., STATE COLLEGE. SCHOOL OF FOREST PFSOURCES.
FOREST SITE AMELIORATION IN THE COASTAL PLATWOODS OF

MISSISSIPPI STATE UNIV., STATE COLLEGE. WATER RESOURCES RESEARCH INST.
MISSISSIPPI WATER RESOURCE CONFERENCE - 1969.

MISSOURI UNIV., COLUMBIA. DEPT. OF SOILS.
POTENTIAL EVAPOTRANSPIRATION IN HUNID AND ARID CLIMATES, W69-08310

NAPLES UNIV. (ITALY). HYDRAULIC LAB.
STREAMS IN LARGE ALLUVIAL BEDS OF HIGH SLOPE,

NATIONAL AND UNIV. INST. OF AGRICULTURE, REHOVOTH (ISRAEL). STONATAL INFILTRATION MEASUREMENTS AS AN INDICATOR OF THE WATER REQUIREMENT AND THING OF IRRIGATION FOR COTTON,

NATIONAL RESEARCH CENTER FOR DISASTER PREVENTION, TOKYO

(JAPAN).

ON A METHOD OF PLOOD FORECASTING USING A DIGITAL COMPUTER CONNECTED WITH A WEATHER RADAR, W69-08229

02A

A COMPARATIVE ANALYSIS OF DIGITAL AND ANALOG COMPUTERS AS TO THEIR EFFECTIVENESS IN SOLVING RUNOFF ANALYSIS, 02\AA

MATIONAL RESEARCH CENTRE, CAIRO (EGYPT).
WATER ECONOMY OF AGAVE SISALANA UNDER DESERT CONDITIONS, W69-08303

NEBRASKA UNIV., LINCOLN. CONSERVATION AND SURVEY DIV. AND GEOLOGICAL SURVEY, LINCOLN, NEBR. WATER LEVELS IN OBSERVATION WELLS IN NEBRASKA--1968, W69-08588

NEVADA UNIV, RENO. DEPT. OF CIVIL ENGINEERING AND NEVADA UNIV., RENO. CENTER FOR WATER RESOURCES RESEARCH.
AN ENGINEERING-ECONOMIC ANALYSIS OF SYSTEMS UTILIZING AQUIFER STORAGE FOR THE IRRIGATION OF PARKS AND GOLF COURSES WITH RECLAIMED WASTEWATER, W69-08625

NEVADA UNIV., RENO. CENTER FOR WATER RESOURCES RESEARCH.

STOCHASTIC DYNAMIC PROGRAMMING AND THE ASSESSMENT OF RISK, w69-08546

NEW HAMPSHIRE WATER SUPPLY AND POLLUTION CONTROL COMMISSION, PRACTICAL ALGAE CONTROL METHODS FOR NEW HAMPSHIRE WATER

SUPPLIES, W69-08282

NEW MEXICO UNIV., ALBUQUERQUE.
SOME IMPORTANT RESEARCH PROBLEMS IN THE WATER RESOURCES FIELD, W69-08381

NEW SOUTH WALES UNIV., KEWSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING. LAG TIME OF NATURAL CATCHMENTS, W69-08250 02E

NORTH CAROLINA STATE DNIV., RALEIGH.

FUTURE ECONOMICS RESEARCH ON WESTERN WATER RESOURCES -- WITH
PARTICULAR REPERENCE TO CALIFORNIA, 06B

NORTH CABOLINA UNIV., CHAPEL HILL. RESEARCH ON COMPREHENSIVE PLANNING OF WATER-RESOURCE STSTEMS, W69-08382 06B

NORTH CAROLINA UNIV., CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
ELIMINATION OF IODINE, COBALT, IRON, AND ZINC BY MARINE W69-08523

ELIMINATION AND TRANSPORT OF COBALT BY MARINE ZOOPLANKTON, W69-08529

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGY BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W69-08565 DEPT. OF BIOLOGY.

OAK RIDGE NATIONAL LAB., TENN. CHEMISTRY DIV.
OBSERVED DIFFRACTION PATTERN AND PROPOSED MODELS OF LIQUID

OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER, PARIS (PRANCE).

DESCRIPTION OF THE HYDROLOGIC REGIME OFF THE GRAIN AND IVORY COASTS BETWEEN ABIDJAN AND MONROVIA (PRENCH),

OREGON STATE GAME COMMISSION, CORVALLIS. RESEARCH DIV. PRODUCTION OF JUVENILE STEELHEAD TROUT IN A FRESHWATER IMPOUNDMENT,

OREGON STATE UNIV., CORVALLIS AND BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB.
METABOLISM OF ZINC-65 IN EUPHAUSIIDS, W69-08276

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ECONOMICS AND OREGON STATE UNIV., CORVALLIS. WATER RESOURCES RESEARCH INST. CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL BESEARCH ON THE ECONOMICS OF WATER, W69-08346 W69-08386 06B

OREGON STATE UNIV., CORVALLIS. DEPT. OF OCEANOGRAPHY.
RADIOZINC DECLINE IN STARRY FLOUNDERS AFTER TEMPORARY
SHUTDOWN OF HANPORD REACTORS, W69-08270

THE EFFECT OF TEMPERATURE, SEDIMENT, AND FEEDING ON THE BEHAVIOR OF FOUR RADIONUCLIDES IN A MARINE BENTHIC AMPHIPOD, W69-08522

RADIOISOTOPE MEASUREMENTS OF THE VISCERA OF PACIFIC SALMON,

 ${\tt ZINC-65}$ in Echinoderms and sediments in the Marine environment off oregon, W69-08531

OREGON STATE UNIV., CORVALLIS. PACIFIC COOPERATIVE WATER POLLUTION AND FISHERIES RESEARCH LABS.

EXPERIMENTS ON THE DISSOLVED OXYGEN REQUIREMENTS OF COLD-WATER FISHES, W69-08516

OTTAWA UNIV., ONTARIO. DEPT. OF GEOLOGY.
THE SEDIMENTOLOGY OF A BRAIDED RIVER,
W69-08580 02J

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF GEOLOGY AND GEOPHYSICS AND NATIONAL IRANIAN OIL CO., NEW YORK. A CONTACT GAGE POR RAPID AND ACCURAGE THREE-DIMENSIONAL GRAIN SIZE MEASUREMENT OF LOGSE SAND PARTICLES, #69-08584

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF SOIL TECHNOLOGY.

CROP RESPONSE TO SEWAGE EPPLUENT, W69-08617 050

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
CRUSHED LIBESTONE BARBIERS A BASIC PEASIBILITY STUDY IN THE NEUTRALIZATION OF ACID STREAMS, ¥69-08376 SG

RENOVATION OF WASTE WATER THROUGH APPLICATION TO AGRICULTURAL CROPLAND AND FORESTLAND, $969\!-\!08377$

WATERSHED THERMAL CLIMATES AND WATER LOSS PREDICTION, H69-08378

BIOLOGICAL OXIDATION RATES IN MINE ACID WATER REGIMES,

AN INVESTIGATION OF POTENTIAL INTERACTIONS OF COAL AND COAL PRODUCTS FOR USE IN THE TREATMENT OF MINE DRAINAGE WATERS, $\$69{\text -}08466$

PUBLIC HEALTH SERVICE, PHILADELPHIA, PA. DELAWARE ESTUARY PUBLIC HEALT STATE OF THE COMPREHENSIVE STUDY.

HATHEMATICAL HODEL FOR DISSOLVED OXYGEN,

05D

PUBLIC HEALTH SERVICE, ROCKVILLE, MD. DIV. OF ENVIRONMENTAL PUBLIC HEALTH FACTORS IN BEACTOR SITE SELECTION,

PUERTO RICO NUCLEAR CENTER, MATAGUEZ.

THE NATURE OF THE DISTRIBUTION OF TRACE ELEMENTS IN LONGNOSE

ANCHOVY (ANCHOR LAMPROTAENIA HILDEBRAND), ATLANTIC THREAD HERRING (OPISTHONEMA OGLINUM LASUEUR), AND ALGA (UDOTEA FLABELLUM LANGUROUX),

PUERTO RICO NUCLEAR CENTER, MAYAGUEZ. MARINE BIOLOGY PROGRAM.

TRACE ELEMENT COMPOSITION OF INSHORE AND OFFSHORE BENTHIC

POPULATIONS, W69-08528

- RAYTHEON CO., WALTHAM, MASS. AN APPLICATION OF LINEAR PROGRAMMING TO EFFICIENCY IN OPERATION OF A SYSTEM OF DAMS, M69-08536 04A
- READING UNIV. (ENGLAND). SEDIMENTOLOGY RESEARCH LAB. BROSIONAL CURRENT MARKS OF WEAKLY COHESIVE HUD BEDS,
- RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST SOME PROBLEMS OF STREAMPLOW FORECASTS BASED ON INFORMATION THEORY,
- RESOURCES FOR THE PUTURE, INC., WASHINGTON, D. C. ECOMONIC AND RELATED PROBLEMS IN CONTEMPORARY WATER RESOURCES MANAGEMENT, 48F80-039
- ROBERT A. TAPT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. CINCINNATI WATER RESEARCH LAB.

 OPERATIONS RESEARCH ACTIVITIES AT CINCINNATI WATER RESEARCH LABORATORY, W69-08534 05D
- BERT S. KERR WATER RESEARCH CENTER, ADA, OKLA. SOIL RESPONSE TO SEWAGE EPFLUENT IRRIGATION, W69-08616
- ROCKY MOUNTAIN POREST AND RANGE EXPREIMENT STATION.

 EFFECT OF HEAVY LATE-PALL PRECIPITATION ON RUNOFF FROM A
 CHAPARRAL WATERSHED,
 W69-08285
- ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND). SURFACE RESISTANCE OF CROP CANOPIES, W69-08573 O2D
- RUTGERS THE STATE UNIV., NEW BRUNSWICK, N.J.
 DISTRIBUTED PARAMETER HODEL OF THERMAL EFFECTS IN BIVERS, W69-08394
- SANDY HOOK MARINE LAB., HIGHLANDS, N. J.

 LABORATORY INVESTIGATION OF THE EFFECTS OF THERMAL ADDITIONS
 ON MARINE ORGANISMS CHARACTERISTIC OF CAPE COD CANAL,

 05C
- SASKATCHEWAN UNIV., SASKATOON.
 MORPHOMETRY AS A DOMINANT PACTOR IN THE PRODUCTIVITY OF
 LARGE LAKES, 02H
- SCOTT PAPER CO., PHILADELPHIA, PA.
 THE ECONOMICS OF CLEAN WATER,
 W69-08548

057

- SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIF.
 AN ESTIMATE OF THE RESPONSE RATE OF ALBACORE TO CESIUM,
 W69-08271
- SOIL CONSERVATION SERVICE, SEARCY, ARK. AND LOUI POLYTECHNIC INST., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING. AND LOUISIANA
- GINEBRING.
 A TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF THE USE OF MUNICIPAL SEWAGE EFFLUENT FOR IRRIGATION,
 1400-0042-3 05D
- SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF ECONOMICS AND ECONOMIC RESEARCH SERVICE, BROOKINGS, S. DAK. REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION, 869-08391
- SOUTHAMPTON UNIV. (ENGLAND) SOUTHAMPTON HARBOUR BOARD (ENGLAND) AND CENTRAL ELECTRICITY GENERATING BOARD, SOUTHAMPTON (ENGLAND).
 AN INVESTIGATION INTO THE EFFECTS OF WARRED WATER FROM MARCHWOOD POWER STATION INTO SOUTHAMPTON WATER, 05C0
- SOUTHEAST WATER LAB., ATHEMS, GA. AND MISSISSIPPI AIR AND POLLUTION COMPROL BOARD, JACKSON.

 BACTERIOLOGICAL WATER QUALITY OF SEVERAL RECREATIONAL AREAS IN THE ROSS BARNETT RESERVOIR,

 W69-08563

 05B
- STANFORD UNIV., CALIF. DEPT. OF CIVIL ENGINEERING.
 THE ROLE OF UNCERTAINTIES IN THE ECONOMIC EVALUATION OF WATER-RESOURCES PROJECTS, 06B
- STATE HYDBOLOGICAL INST., LENINGRAD (USSE).

 GAMMA CORRELATION AND ITS USE IN COMPUTATIONS OF LONG-TERM
 STREAMFILM REGULATION,
 M69-06612

 07C
 - PATTERNS OF SUCCESSION OF DRY AND WET YEARS AS A BASIS FOR COMPUTATIONS OF STREAMFLOW REGULATION, 07C

- SOME STATISTICAL METHODS IN THE ANALYSIS OF HYDROLOGIC
- STATE UNIV. OF IOWA, IOWA CITY. DEPT. OF ECONOMICS. REGIONAL ECONOMIC DEVELOPMENT AND WATER, W69-08387 06B
- WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
- STATE UNIV. OF NEW YORK, BINGHAMTON. DEPT. OF GEOLOGY.
 RECENT CARBONATE SEDIMENTATION BY TIDAL CHANNELS IN THE
 LOWER FLORIDA REIS,
 W69-08577 021
- TECHNION ISRAEL INST. OF TECH., HAIF NET LOSSES IN SPRINKLER IBRIGATION, #69-08305 HAIFA.
- TECHNION ISRAEL INST. OF TECH., HAIFA. DEPT. OF AGRICULTURAL ENGINEERING. RANDOM WALK AND RANDOM ROUGHNESS MODELS OF DRAINAGE
- TECHNION ISRAEL INST. OF TECH., HAIFA. LOWDERHILK FACULTY
 OF AGRICULTURAL ENGINEERING.
 A REVIEW OF SOME APPLICATIONS OF MATHEMATICAL PROGRAMMING IN
 WATER RESOURCES ENGINEERING, R69-08251
 - AN INVENTORY OF PROBLEMS IN WATER RESOURCES ENGINEERING, $06\,\text{\AA}$
- TENNESSEE VALLEY AUTHORITY, KNOXVILLE. SOURCE AREAS OF STORM RUNOFF, W69-08569
- AND M UNIV., COLLEGE STATION AND FLORIDA UNIV., TEXAS A AND A UNIV., COLLEGE STATES AND TEXT OF THE SAME SAME SAME ACCURATE AND ACC
- TEXAS A AND M UNIV., COLLEGE STATION AND KANSAS UNIV., LAWRENCE.
 SORPTION OF RADIOACTIVE NUCLIDES BY SARGASSUM FLUITANS AND S NATANS.
- TEXAS TECHNOLOGICAL COLL. LUBBOCK. WATER RESOURCES CENTER AND TEXAS TECHNOLOGICAL COLL., LUBBOCK. DEPT. OF ENGINEERING. GROUNDWATER RECHARGE WITH TREATED MUNICIPAL EFFLUENT, W69-08620 05D
- TEXAS TECHNOLOGICAL COLL., LUBBOCK.

 POTENTIAL REUSE OF EFFLUENT AS A FACTOR IN SEWERAGE DESIGN,
 W69-08262 05D
- TREATING WASTES IN A WATER-SHORT AREA, W69-08551
- TEXAS WATER DEVELOPMENT BOARD, AUSTIN.
 RETURN PLOWS A REUSABLE WATER RESOURCE,
 #69-08259
- TRAVELERS RESEARCH CENTER, INC., HARTFORD, CONN.
 COMPUTATIONAL ANALYSES OF HOISTURE FLUX OVER NORTH AMERICA,
- TRAVELERS RESEARCH CORP., HARTFORD, CONN.
 A SYSTEMS ANALYSIS OF AQUATIC THERMAL POLLUTION AND ITS IMPLICATIONS VOLUMES 1, SUMMARY REPORT,
- UNIVERSIDAD MACIONAL DEL ZULIA, MARACAIBO (VENEZUELA) AND GEOLOGICAM SURVEY, FORT COLLINS, COLO.

 SOME APPLICATIONS OF CROSS-SPECTRAL ANALYSES IN HYDROLOGY RAINFALL AND RUNOFF, W69-08572
- UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
 AN IMPERENTIVE RECORDING SETTLING TUBE FOR ANALYSIS OF SANDS,
 W69-08582
- UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES. DEPT. OF UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGÉLES. DEPT. BIOLOGY.

 CALIBRATION OF THE UNIVERSITY OF SOUTHERN CALIFORNIA AUTOMATICALLY RECORDING SETTLING TUBE, 97B
- UTAH STATE UNIV., LOGAN. DEPT. OF IRRIGATION. SALT BUILD-UP FROM SEWAGE EFFLUENT IRRIGATION, w69-08618
- UTAH WATER BESEARCH LAB., LOGAN.
 A DIGITAL COMPUTER PROGRAM TO PLOT ISOHYETAL MAPS AND CALCULATE VOLUMES OF PRECIPITATION.
- VANDERBILT UNIV., WASHVILLE, TENN.
 THE VARIATION OF WATER TEMPERATURES DUE TO STEAM ELECTRIC COOLING OPERATIONS,
- VANDERBILT UNIV., MASHVILLE, TEWN. DEPT. OF SANITARY AND WATER RESOURCES ENGINEERING.
 STATUS OF RADIOACTIVE WASTE DISPOSAL IN U.S.A.,

W69-08214 05E

VANDERRILT UNIV., NASHVILLE, TENN. AND JOHNS HOPKINS UNIV., BALTIHORP, MD. ANALYZING STRAM POWER PLANT DISCHARGES, W69-08411

VANDERBILT UNIV., NASHVILLE, TENN. OPPICE OF THE SURGEON GYMERAL (ARMY) (SOUTH VIETNAM) AND JOHNS HOPKINS UNIV., BALTIHORE, ND. THE RESPONSE OF WATER TEMPFRATURES TO HETEOROLOGICAL

VIRGINIA POLYTECHNIC INST., BLACKSBURG, VA.
RESPARCH ON TREATMENT OF DYE WASTES,
W69-08558 05D

VIRGINIA WATER CONTROL BOARD, RICHMOND, VA.
WATER QUALITY MANAGEMENT IN VIRGINIA,
W69-08554 056

WARSAW UNIV. (POLAND). PACULTY OF BIOLOGY WARSAW UNIV. (POLAND). FACULTY OF GEOGRAPHY AND WARSAW UNIV. (POLAND). PACULTY OF GEOPHYSICS. AN OUTLINE OP POLAND'S HYDROGPAPHY (POLISH), W69-08253

WASHINGTON UNIV., SPATTLE. COLL. OF FISHERIES.
DISTRIBUTION OF RADIONUCLIDES IN THP ENVIRONMENT OF ENIWETOK
AND BIKINI ATOLS, AUGUST 1964.

WASHINGTON UNIV., SEATTLE. FISHFRIES RESEARCH INST. AND INTER-AMERICAN TROPICAL TUNA COMMISSION, LA JOLLA, CALIF. THE CONCENTRATION OF 2N-65 BY OSTERS HALVAINED IN THE DISCHARGE CANAL OF A NUCLEAR POWER PLANT,

WATER RESOURCES ENGINPERS, INC., WALNUT CREEK, CALIP. ESTUARIAL SYSTEMS ANALYSIS QUANTITY AND QUALITY CONSIDERATIONS, W69-08537 02L

WEATHER BURBAU, PORTLAND, OREG. RIVER FORECAST CENTER.

OPERATIONAL STREAMFLOW FORECASTING WITH THE SSARR HODEL,

#89-08245 022

WEATHER BUREAU, SACRAMENTO, CALIF. RIVER FORECAST CENTER.
AN OPERATIONAL SYSTEM FOR COMPUTER PREPARATION OF SHORT-TERM
SIVER FORECASTS ON THE NORTH COAST OF CALIFORNIA,

WEST VIRGINIA UNIV., MORGANTOWN.
SURVIVAL AND ACTIVITY OF SEWAGE MICROORGANISMS IN ACID MINE WATER, W69-08400

WISCONSIN UNIV., MADISON.
PLANT NUTRIENTS IN BASE PLOW OF STREAMS IN SOUTHWESTERN WISCONSIN,

WISCONSIN UNIV., MADISON. DEPT. OF METEOROLOGY.
HEAT BUDGET OF AN ICP COVERED INLAND LAKE, H69-08404

WISCONSIN UNIV., MILWAUKEE.
A PRECLASSIC WATER DISTRIBUTION SYSTEM IN AMALUCAN, MEXICO,
07B

WOODS HOLE OCEANOGRAPHIS INSTITUTION, MASS. PRECIPITATION AND LITHIPICATION OF DEEP-SEA CARBONATES IN THE RED SEA, W69-08581

YALE UNIV., NEW HAVEN, CONN. OSBORN ZOOLOGICAL LAB. STUDIES ON CONNECTICUT LAKE SEDIMENTS. II. CHEMICAL ANALYSES OF A CORE PROM LINSLEY POND, NORTH BRANFORD, W69-08521 02H

ZAGREB UNIV. (YUGOSLAVIA). GEOPHYSICAL INST.
THE APPLICATION OF GEORLECTRICAL METHODS FOR GROUND-WATER
EXPLORATION OF UNCONSOLIDATED FORMATIONS IN SEMI-ARID AREAS,
W69-08297
078

ACCESSION NUMBER INDEX

			W/O 0020E	٥٥٢	w69-08286	04C	w69-08365
05G	W69-08127	05B	W69-08205 W69-08206	02F 02F	W69-08287	05G	W69-08366
06E	W69-08128	020	W69~08207	02F	W69-08288	06E	W69-08367
06E	W69-08129	020	W69-08208	05D	W69-08289	06E	W69-08368
04A	W69-08130	02B 02D	W69-08210	05D	W69-08290	06E	W69-08369
06E	W69-08131	07A	W69-08211	021	W69-08291	04D	W69-08370
06E	W69-08132	05G	W69-08212	02D	W69-08292	06E	W69-08371
06E	W69-08133	05G	W69-08213	03F	W69-08293	04A	W69-08372
06E	W69-08134	05E	W69-08214	04B	W69-08294	05G	W69-08373
06E	W69-08135	05D	W69-08215	03A	W69-08295	06E	W69-08374
06E	W69-08136	05G	W69-08216	02F	W69-08296	04C	w69-08375
06E	W69-08137	05A	W69-08217	07B	W69-08297	5G	w69-08376
06E	W69-08138	02K	W69-08218	03C	W69-08298	05D	W69-08377
06E	W69-08139	05A	W69-08219	02F	W69-08299	02D	W69-08378
06E	W69-08140	05C	W69-08220	02F	W69-08300	05G	W69-08379
06E	W69-08141	02E	W69-08221	03C	W69-08301	06B	W69-08380
06E	W69-08142	05C	W69-08222	03F	W69-08302	06B	W69-08381
06E	W69-08143	02J	W69-08223	03F	W69-08303	06B	W69-08382
06E	W69-08144	04A	W69-08224	07A	W69-08304	06B	W69-08383
06E	W69-08145	04A	W69-08225	03F	W69-08305	06B	W69-08384
06E	W69-08146	02B	W69-08226	04B	W69-08306	06B	W69-08385
06E	W69-08147	020	W69-08227	02D	w69-08308	06B	W69-08386
06E	W69-08148	05D	W69-08228	02B	W69-08309	06B	W69-08387
06E	W69-08149	02A	W69-08229	02D	W69-08310	06B	W69-08388
04A	W69-08150		W69-08230	04C	W69-08311	10	W69-08389
05G	W69-08151	02A 02G	W69-08231	04C	W69-08312	06D	W69-08390
04A	W69-08152		W69-08232	05G	W69-08313	06B	W69-08391
06E	W69-08153	02E	W69-08233	04C	w69-08314	06B	W69-08392
05E	w69-08154	07A	W69-08234	06E	W69-08315	06B	W69-08393
05G	w69-08155	07C	W69-08235	05G	W69-08316	05C	w69-08394
06E	W69-08156	04B	W69-08236	06E	w69-08317	03A	W69-08395
06E	W69-08157	07C			w69-08318	07B	W69-08396
06E	W69-08158	07C	W69-08237	04A 8C	w69-08319	04A	W69-08397
06E	W69-08159	07C	W69-08238	04A	w69-08320	08B	W69-08398
06E	W69-08160	07C	W69-08239	04C	w69-08321	06G	W69-08399
06E	W69-08161	06A	W69-08240		w69-08322	05D	W69-08400
06E	W69-08162	02E	W69-08241	06E	W69-08323	05C	W69-08401
06E	W69-08163	07C	W69-08242	04A	w69-08324	05B	W69-08402
06E	W69-08164	02A	W69-08243	04A	W69-08325	08B	W69-08403
06E	W69-08165	02B	W69-08244	06E	W69-08326	02H	W69-08404
05G	W69-08166	025	W69-08245	06E	W69-08327	05C	W69-08405
06E	W69-08167	02E	W69-08246	06E		05C	W69-08406
06E	W69-08168	04A	W69-08247	06E	W69-08328	05G	W69-08407
06E	W69-08169	02F	W69-08248	06E	W69-08329 W69-08330	05C	W69-08408
08A	W69-08170	02J	W69-08249	06E	W69-08331	05C	W69-08409
06E	W69-08171	02E	W69-08250	06E	w69-08332	08B	W69-08410
05G	W69-08172	06A	W69-08251	06E	W69-08333	05B	W69-08411
06E	W69-08173	02A	W69-08253	04D	W69-08334	08B	W69-08412
06E	W69-08174	02E	W69-08254	04A	W69-08335	05C	W69-08413
06E	W69-08175	02L	W69-08255	06E	W69-08336	05C	W69-08414
06E	W69-08176	06A	W69-08256	04D 04A	W69-08337	05B	W69-08415
06E	W69-08177	06D	W69-08257		W69-08338	05C	W69-08416
04A	W69-08178	02J	W69-08258	04C	W69-08339	01A	W69-08417
04A	W69-08179	05D	W69-08259	04A	w69-08340	02D	W69-08418
06E	W69-08180	05D	W69-08260	04A	W69-08341	05C	W69-08419
06E	W69-08181	05D	W69-08261	04C	W69-08342	05C	W69-08420
06E	W69-08182	05D	W69-08262	04A	W69-08343	05B	W69-08421
06E	W69-08183	05D	W69-08263	04A	W69-08344	05C	W69-08422
06E	W69-08184	02F	W69-08264	06E	W69-08345	05B	W69-08423
06E	W69-08185	02F	W69-08265	04A	W69-08346	05B	W69-08424
06E	W69-08186	06B	W69-08266	04A	W69-08347	021	W69-08425
06E	w69-08187	05C	W69-08267	06E	W69-08348	02D	W69-08426
06E	W69-08188	05C	W69-08268	05G	W69-08349	02D	W69-08427
06E	w69-08189	05C	W69-08269	05G	W69-08350	02D	W69-08428
06E	W69-08190	05C	W69-08270	05G	W69-00351	02D	W69-08429
06E	W69-08191	05B	w69-08271	05G	w69-08352	02D	W69-08430
06E	W69-08192	05C	W69-08272	04A	W69-08353	02D	W69-08431
06E	W69-08193	05C	W69-08273	05F	w69-08354	021	W69-08432
06E	W69-08194	05C	W69-08274	04A	W69-08355	021	W69-08433
06E	W69-08195	05C	W69-08275	040	W69-08356	021	W69-08434
06E	W69-08196	050	W69-08276	06E	W69-08357	020	W69-08435
06E	W69-08197	050	W69-08277	04A		020	W69-08436
020	W69-08198	02K	W69-08278	05G	W69-08358	04A	W69-08437
05D	w69-08199	05C	W69-08279	06E	W69-08359	04A	W69-08438
03B	w69-08200	02H	W69-08280	04A	W69-08360	02E	W69-08439
02G	W69-08201	05C	W69-08282	04A	W69-08361	04A	W69-08440
02G	w69-08202	02H	W69-08283	06E	W69-08362	04A	W69-08441
02G	w69-08203	05A	W69-08284	06E	W69-08363	04A	W69-08442
05A	W69-08204	02E	W69-08285	06E	W69-08364		
-							

ACCESSION NUMBER INDEX

04A	W69-08443	03B	W69-08490	02L	W69-08537	07B	W69-08583
020	W69-08444	03B	W69-08491	06E	W69-08538	07B	W69-08584
020	W69-08445	06E	W69-08492	06A	W69-08539	07B	W69-08585
020	W69-08446	03B	W69-08493	06A	W69-08540	02J	W69-08586
020	W69-08447	03B	W69-08494	06A	W69-08541	025 02B	W69-08587
020	W69-08448	03B	W69-08495	05D	W69-08542	02F	W69-08588
020	W69-08449	07B	W69-08496	06B	W69-08543		
02C	W69-08450	07A	W69-08497	06A	W69-08544	02E	W69-08589
02C	W69-08451	03B	W69-08498	02E		02E	W69-08590
02C	W69-08452	07B	W69-08499		W69-08545	02E	W69-08591
02C	W69-08453	020	W69-08500	06A 05F	W69-08546	02J	W69-08592
02C	W69-08454	02A	W69-08501		W69-08547	04A	W69-08593
05B	W69-08455	04D	W69-08502	05F	W69-08548	02H	W69-08594
02G	W69-08456	03B	W69-08503	03A	W69-08549	07C	W69-08595
05B	W69-08457	02A	W69-08504	02F	W69-08550	02F	W69-08596
02D	W69-08458	07B	W69-08505	05D	W69-08551	06E	W69-08597
03B	W69-08459	020	W69-08506	05G	W69-08552	02L	W69-08598
021	W69-08460	02J	W69-08507	05G	W69-08553	05C	W69-08599
02G	W69-08461	04D	W69-08508	05G	W69-08554	08A	W69-08600
04A	W69-08462	07B	W69-08509	05G	W69-08555	08A	W69-08601
04A	W69-08463	02G	W69-08510	05D	W69-08556	08A	W69-08602
02G	W69-08464	07C	W69-08511	05G	W69-08557	A80	W69-08603
02G	W69-08465	03B	W69-08512	05D	W69-08558	02E	W69-08604
05D	W69-08466	02G	W69-08513	05A	W69-08559	07C	W69-08605
021	W69-08467	05C	W69-08514	01A	W69-08560	07A	W69-08606
021	W69-08468	05C	W69-08515	05C	W69-08561	02J	W69-08607
07B	W69-08469	05C	W69-08516	05C	W69-08562	02.1	W/0 00/00
021	W69-08470	02H	W69-08517	05B	W69-08563	02J	W69-08608
021	W69-08471	05C	W69-08518		W69-08564	04A	W69-08609
03B	W69-08472	02H	W69-08519	05C 05C	W69-08565	04A	W69-08610
03B	W69-08472	05C	W69-08520	06E	W69-08566	05C	W69-08611
04D	W69-08474	03C 02H	W69-08521	06E	W69-08567	07C	W69-08612
04D	W69-08475	05C	W69-08521	02B	W69-08568	07C	W69-08613
04D	W69-08476	05C	W69-08523	02B	W69-08569	07C	W69-08614
03B	W69-08477	050				05D	W69-08615
03B	W69-08478	050	W69-08524 W69-08525	02A	W69-08570 W69-08571	05D	W69-08616
04D	W69-08479	05C		02E	W69-08571	05D	W69-08617
07B	W69-08480		W69-08526	02A		05D	W69-08618
02D	W69-08481	05C	W69-08527	02D	W69-08573	05D	W69-08619
02J	W69-08482	05C	W69-08528	02F	W69-08574	05D	W69-08620
028	W69-08483	05C	W69-08529	02F	W69-08575	05D	W69-08621
05B	W69-08484	050	W69-08530	02F	W69-08576	05D	W69-08622
03B	W69-08485	05C	W69-08531	02L	W69-08577	05D	W69-08623
03B	W69-08486	05D	W69-08532	02L	W69-08578	07C	W69-08624
06B	W69-08487	06A	W69-08533	02J	W69-08579	05D	W69-08625
02G	W69-08488	05D	W69-08534	02J	W69-08580	02E	W69-08626
03B	W69-08489	06A	W69-08535	02J	W69-08581	020	W69-08627
000	HU7-00407	04A	W69-08536	07B	w69-08582	02A	W69-08628

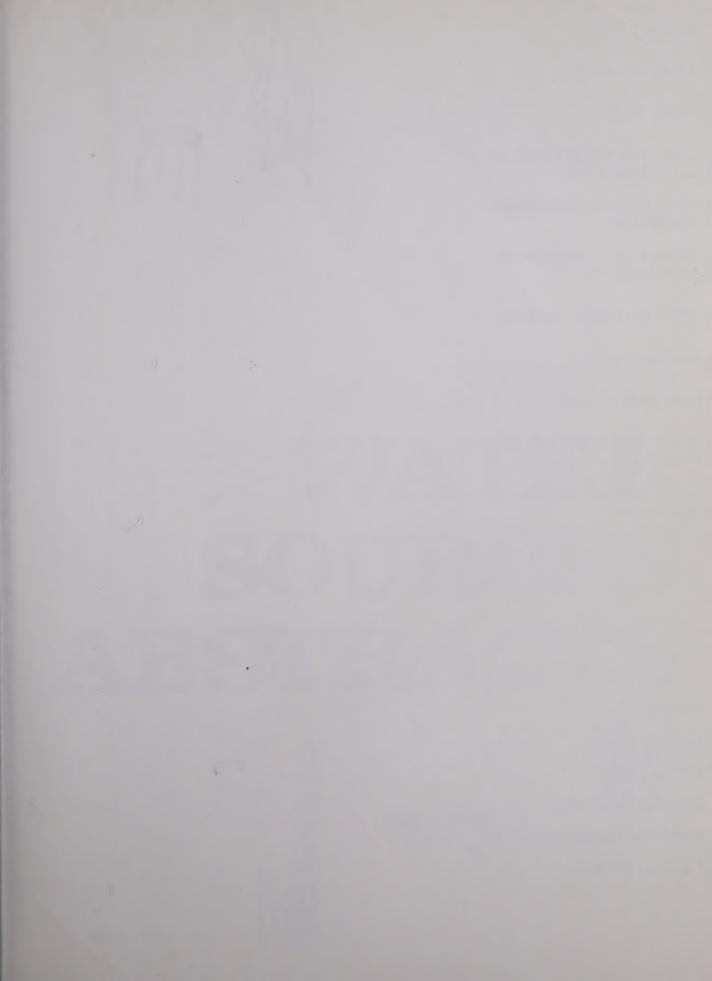
ABSTRACT SOURCES

Sou	rce	Accession Numbers	Total
Α.	Centers of Competence:		
	U.S. Geological Survey - Hydrology	W69-08198 W69-08266 W69-08559 W69-08628	137
	University of Florida - Eastern U.S. Water Law	W69-08127 W69-08197 W69-08311 W69-08375	136
	University of Wisconsin - Eutrophication	W69-08267 W69-08284 W69-08514 W69-08531	35
	University of Arizona - Arid Lands Water Resources	W 69 - 0 82 85 W 69 - 0 83 10	25
	University of Chicago - Metropolitan Water Resources Management	W69-08380 W69-08384	5
	Rutgers University - Water Resources Economics	W69-08385 W69-08393	9
	·Vanderbilt University - Thermal Pollution	W69-08401 W69-08423	23
	Cornell University - Policy Models for Water Resources Systems	W69-08532 W69-08550	19
	North Carolina State University - Textile Wastes	W 69-08551 W 69-08558	8
В.	Government Agencies:		
	Forest Service, U.S. Department of Agriculture	W69-08435 W69-08513	79
	Agricultural Research Service, U.S. Department of Agriculture	W69-08425 W69-08434	10
	Office of Saline Water, U.S. Department of Interior	W 69-08395	1
	Federal Water Pollution Control Administration, U.S. Department of Interior	W 69 -0 8424	1
	Office of Water Resources Research, U.S. Department of Interior	W69-08396	1
c.	State Water Resources Institutes:		
	New Jersey Water Resources Research Institute	W 69-08394	1
	Pennsylvania institute for Research on Land and Water Resources	W69-08376 W69-08379	4
	Mississippi Water Resources Research Institute	W69-08397 W69-08399	3
	West Virginia Water Research Institute	W69-08400	1
		Total	498









Subject Fields

NATURE OF WATER

WATER CYCLE

WATER SUPPLY AUGMENTATION AND CONSERVATION

WATER QUANTITY MANAGEMENT AND CONTROL

WATER QUALITY MANAGEMENT AND PROTECTION

WATER RESOURCES PLANNING

RESOURCES DATA

ENGINEERING WORKS

MANPOWER, GRANTS, AND

SCIENTIFIC AND TECHNICAL INFORMATION

LIBRARY RATE PRINTED MATTER

U.S. DEPARTMENT OF COMMERCE

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

U.S. DEPARTMENT OF COMMERCE CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION Springfield, Va. 22151

OFFICIAL BUSINESS

M MARTINELLI JE RCKY MNTN FOR & 240 WEST PROSPE FORT COLLINS

SHRA

JE ERANGE